USDA/ARS
NC7 Annual Report
January 1 - December 31, 2014

USDA

Maize

North Central Regional Plant Introduction Station

Amaranth

Oilseeds

Entomology

Seed Storage

Vegetables

Horticulture

Germination

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

NCRPIS
AMES, IOWA

NCRPIS ANNUAL REPORT - 2014

TABLE OF CONTENTS

NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2014

I. PROJECT TITLE:

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

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS (current):

A. Administrative Advisor

*W. Wintersteen, Iowa

B. Regional Coordinator

*C. Gardner, USDA-ARS, Iowa

C. State Experiment Stations Representatives

Voting members:

1. Illinois	E. Sacks	7. Missouri	J. Shannon
2. Indiana	J. Janick	8. Nebraska	D. Santra
3. Iowa	T. Lübberstedt	9. N. Dakota	B. Johnson
4. Kansas	M. Stamm	10. Ohio	P. Jourdan
5. Michigan	A. Iezzoni	11. S. Dakota	Vacant
6. Minnesota	Vacant	12. Wisconsin	W. Tracy

Non-voting participants:

13. California-Davis	R. Karban	24. Missouri	S. Flint Garcia
14. Connecticut	M. Brand	25. Missouri	S. Jose
15. Delaware	R. Wisser	26. Nebraska	C. Urea
16. Illinois	J. Juvick	27. New Jersey	S. Handel
17. Illinois	G. Kling	28. New Jersey	T. Molnar
18. Illinois	S. Korban	29. New York	P. Griffiths
19. Illinois	D. Lee	30. New York	M. Smith
20. Iowa	K. Lamkey	31. Texas	D. Baltensperger
21. Kansas	A. Fritz	32. Wisconsin	N. de Leon
22. Kentucky	T. Phillips	33. Wisconsin	S. Kaeppler
23. Michigan	J. Hancock		

D. U. S. Department of Agriculture (*Voting members)

1. ARS National Program Staff, Plant Germplasm	*P. Bretting
2. ARS Plant Exchange Office	*G. Kinard
3. ARS Area Director, Midwest Area	R. Matteri
4. Cooperative State Research, Education and Extension Service	A. Thro
5. National Center for Agric. Util. Research	*T. Isbell
6. National Center for Genetic Resources Preservation	*S. Greene

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

See organizational chart, Figure 1 in the Appendix.

III. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Personnel changes – January, 2014 – June, 2015:

Departures:

- Dr. Michael Blanco, GEM Coordinator/Maize Geneticist, retired June, 2014
- Bill Van Roekel, Pathology Agri. Research Science Technician, January, 2014
- Vivian Bernau, Temporary Technician, GEM, August, 2014
- Brady North, ISU Agr. Specialist II, Maize Curation, November, 2014
- Bruce Hall, Maize Curation ASRT, January, 2015

Promotion:

- Jeff Carstens, from Horticulture Agri. Research Science Technician to Category III Horticulturist, Woody Ornamentals

New Hires:

- David Zimmerman, ISU Ag Specialist II, Maize Curation, April, 2015
- Narinder Pal, Plant Pathology ASRT, May, 2015

Transitions:

- Jeff Carstens, promoted to CAT III Curator, Woody Ornamentals (was an ASRT)

Vacant Positions:

- GEM Project Coordinator / Maize Geneticist (vice-Blanco)
- Two Biological Science Technicians, support for germination and seed storage;
- Entomology Agri. Research Science Technician (vacant since 2010)
- Horticulture ASRT (vice-Carstens)
- Maize Curation ASRT (vice-Hall)
- CAT IV Maize Curator (geneticist), NEW
- CAT III Agronomist (IT), Seed Inventory Process and Data Management, NEW

Management of Federal and ISU Student Temporary Employees:

USDA-ARS resources provided for 19 student part-time temporary positions in FY 2014, and NC7 resources provided for an addition 1.5 student FTE. The temporary positions support curatorial activities including regeneration, seed processing, viability testing, farm and facilities operations, and IT support. Students were interviewed and selected by ISU Program Manager Larry Lockhart or ARS technicians. Marci Bushman and Susan Siev managed the administrative aspects of all federal student hires, with support and guidance from Ames ARS HR Specialist Kim Grandon and Admin. Officer Carol Moran.

Budget:

We appreciate the support of the Agricultural Experiment Stations of the North Central Region, which have maintained their annual support and continued to provide $522,980 in Hatch funds. These funds support the salaries of our nine ISU staff members, their professional travel, and some expenses. In addition, Iowa State University's Agricultural Experiment Station provides support valued at over $400,000 annually that supports infrastructure, administration, and benefits for current NCRPIS-ISU staff members and retirees.

We are grateful that Hatch funding resources were maintained throughout the difficult sequestration period, and hope they continue to be stable or increase in the future. Currently, about 95% of Hatch NC7 funds are devoted to the wages and salaries of the nine permanent ISU employees.

Fortunately, we received additional FY2014 USDA-ARS funding allocations which brought funding back to the FY2010 funding levels for both projects and about $60,000 more, with implementation instructions to support maize curation and GRIN-Global System development. FY2015 funding is essentially the same as final FY2014 funding, with the PI CRIS funded at $2.38M (net to location) and GEM CRIS at $1.2M. Student hiring for summer 2015 is at full capacity, with about 38 students fulfilling the need for 25 summer FTE. We have received approval to hire additional technical staff for seed storage and germination, and to fill the vacant horticulture technician. GEM Coordinator hiring is in progress, with interviews planned in June. The new maize curator and agronomist (IT) positions have not yet been submitted for approval. Hopefully by next year's report these positions will be filled.

Any further reductions in funding will force reduction in student hiring, necessary for executing our genebank's mission. Like many other research units, our ability to cover all aspects of our mission is challenged; our personnel strive to cover all functions and serve the collections entrusted to us and our stakeholders to the best of our ability.

Construction and Facilities:
The two gas-fired dryer burners and plenum installed in 2014 have functioned very well, and offer both better technical and safety control features than the former system which suffered fire damage.

A planned project to provide backup generator capacity to the station in three phases could not be completed in 2014 due to contracting issues, and will again be bid in 2015.

The roofs of the headquarters building and the GEM seed storage cooler building need attention. We intend to contract for roof coatings that will extend the lifetime of the roof by several decades.

Seed storage space is becoming limiting, and must be addressed in the next five years. In general, space is extremely tight for all personnel and functions.

Please see the Information Management section of this report for details on upgrades that continue to enhance the NCRPIS' information technology infrastructure. The continued implementation virtual servers and their configuration is noteworthy.

Equipment:
Changes directed towards energy savings and improving plant growth conditions included replacement of less than half of the high pressure sodium light fixtures in greenhouse #3 with LED fixtures in 2014. In addition to greatly improved plant growth and development observed under the LEDS, energy costs were reduced for the entire greenhouse by more than one-third. As funding becomes available, we will continue to upgrade lighting technology to improve plant productivity and reduce

costs. LED lighting is rapidly evolving, and fixtures that provide for improved photosynthetic efficiency will become available at less cost.

USDA provided funding to complete the replacement of all T-12 lighting fixtures at the station.

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

(Part IV. summarizes the accomplishments and progress for calendar year 2014 presented in greater detail in the individual staff reports in the document.)

Acquisition and Documentation Highlights:
In 2014, (Appendix Table 1) 766 new accessions were acquired. This compares with 192 new accession in 2014, 470 in 2012, 485 in 2011, 516 in 2010, and 521 in 2009. New ornamentals include a wide variety of taxa from the Bureau of Land Management's Seeds of Success program. Our staff participated in collection expeditions that acquired *Fraxinus, Diervilla, Spirea, Betula, Gymnocladus,* and other ornamentals from Iowa, Illinois, Missouri, Arkansas, Alabama and Mississippi; and *Helianthus* from New Mexico and California.

Additional sources are extensive and detailed in the curator's respective report sections. Of note is the provision of 59 *Setaria* accessions representing wild-collected samples from the US by the Donald Danforth Plant Science Center in St. Louis, Missouri. These are intended for distribution for genetic research activities at multiple locations, and will not become permanent elements of the collection.

International collection continues to be challenging as countries adopt variations of the SMTA or additional requirements that the NPGS cannot accept. Of ongoing concern is the successful entry of germplasm collected from international explorations into the U.S. It is critical that clean, pest- and pathogen-free seed be shipped or carried in by collectors; sufficient time needs to be devoted to collection sample preparation and sufficient care post-collection. Excellent quantities of seed provided by collectors of many new accessions have made a significant proportion available and distributable immediately.

Permanent PI numbers were assigned to 221 accessions in 2014. Taxonomic re-identification was completed for 32 accessions; 133 accessions were nominated for inactivation. R. Stebbins continues to enter old passport information from logbooks for early Ames-numbered accessions.

The *Baptisia* collection was prepared for transfer to the Ornamental Plant Germplasm Center in Ohio.

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

Regeneration and Maintenance Highlights:
In 2014, 1,230 accessions were newly grown for regeneration and 1,085 were harvested, as compared to 1,184 grown and 1,048 harvested in 2013; 759 accessions grown and 954 harvested in 2012; and 1,069 grown and 1,017 harvested in 2008 (Appendix Table 2). 2014 growing conditions can be summarized as too wet early, very dry in June-August, and generally cooler than normal, followed by a wet, coo1 fall. An additional 422 perennials were grown in permanent plantings. About 974 accessions were made available to the public. Accessions backed up at the NCGRP in Ft. Collins in 2013 numbered 1,231, compared with 781 in 2013, 799 in 2012, 792 in 2011, 2,388 in 2010 and 1,848 in 2009. Eighty percent of NCRPIS collection holdings are backed up at the NCGRP (Appendix Table 2). Overall collection availability is 76%, an increase of 2% since 2012, despite 7% growth in collection size since 2006. Additional accessions (741) were sent to Ft. Collins for assembly with accessions from other NPGS sites for deposit to the Svalbard Global Germplasm Vault.

Assistance in regeneration was provided by USDA-ARS staff of Parlier, CA for increase of wild *Helianthus* taxa. *Daucus* regeneration efforts were supported by seed increases from Seminis Vegetable Seeds (R. Yzquierdo), Nunhems (R. Freeman), Bejo Seeds (R. Maxwell), and Vilmorin (J. Cervantes).

Assistance for maize regeneration and observation was provided for tropical maize populations by Monsanto (D. Butruille) in Hawaii, and by DuPont Pioneer in Puerto Rico. USDA-ARS staff of Mayaguez, PR (R. Goenaga) and the St. Croix quarantine nursery staff supported regeneration of 20 maize accessions. Raleigh ARS GEM Project Coordinator Matt Krakowsky provided increases of 14 GEM lines, and Ames GEM staff of 6 GEM lines. Seth Murray (Texas A&M Univ.) donated 9 Texas inbreds, 14 Texas landraces, 5 downy mildew resistant synthetics, and 16 CML lines that they had been maintaining. Nine Journal of Plant Registration (JPR) synthetics from the University of Hawaii were received. Seed of the sequenced maize inbred W23 bz2 was received from Virginia Walbot (Stanford) and of Oh545 from Dr. Mark Jones. There were 28 expired or soon to be expiring PVPs received.

Spinach regenerations continue to be supported by cooperative efforts between the USDA-ARS and Sakata Seed America, Inc. in Salinas, CA.

Distribution:
2014 external distributions included 41,655 items of 17,558 unique accessions to fulfill 1,285 orders from 993 requestors. This compares with the record 2012 distribution of 45,115 items of 18.811 unique accessions to fulfill 1,632 orders from 1,344 requestors; 2013 distributions of 40,409 items of 17,788 accessions to fulfill 1,523 orders from 1,204 requestors; 2011 distributions of 38,402 items of 18,634 accessions to fulfill 1,501 orders from 1,180 requestors; 2010 distributions of 26,651 items of 13,226 accessions; and 2009 distributions of 26,904 items of 13,515 accessions to fulfill 1,487 orders from 1,081 requestors. Approximately 42% were distributed internationally and 58% to domestic researchers, (Appendix Table 3A). The relative numbers of distributions generally correlate well with the proportional makeup of the collections and vary from year to year, although demand for maize is usually greater than for other crops.

Curator	Collection Size 2014	% of Total Collections	% of 2014 Distributions	Collection Size 2013	% of Total Collections	% of 2013 Distributions
Barney	1721	3	1	1507	3	1
Brenner	9087	17	14	8985	17	9
Carstens	1839	3	<1	1709	3	<1
Marek	11987	23	16	11548	22	28
Millard	20794	39	35	20679	40	44
Reitsma	7719	15	28	7695	15	18
Totals	**53147**	**100**	**100**	**52123**	**100**	**100**

Research demand for our plant genetic resource collections continues to be very high; requests for diversity and relationship analyses, disease resistance, biofuel, and health and nutrition contribute increasingly to these increases, as well as for basic research applications such as photoperiod response, and an array of performance traits. Demand for *Zea mays* inbred lines, vegetables, *Helianthus*, Brassicaceae, flax, *Daucus,* quinoa and the culinary umbels for evaluation and characterization were particularly high. Maize inbred requests were driven by the continuing publication of information from genomic (genotyping by sequencing) and phenotypic analyses projects.

NPGS curators at all sites continue to receive many requests from individuals not affiliated with research institutions, generally for home gardening (Appendix Table 3B). Nearly one-fourth of all requests must be cancelled. Home gardeners are redirected to other sources of commercially available materials. Although our resources cannot support maintaining and distributing the collections to home gardeners, we inform these requestors about plant genetic resource conservation and encourage interested individuals to save seeds, conserve them, and share germplasm and associated information. The proliferation of websites instructing non-research requestors how to deceive curators at various germplasm sites in order to get free germplasm continues to be problematic. The careful efforts that go into each and every increase, characterization, imaging, processing, storage, viability testing, and distribution surely make these seeds among the most expensive to provide in the world.

Evaluation and Characterization:
In 2014, the NCRPIS utilized 711 accessions internally for observation, evaluation and characterization for a wide array of descriptor information. Six percent of the collection was tested for viability. Other uses include pathogen testing to meet international distribution requirements and back up. About 48,800 observations associated with 6,689 accessions were entered in the GRIN database (http://www.ars.grin.gov/npgs/). Few images were added to GRIN (Appendix Table 4), and a backlog of images will be added to GRIN-Global following NPGS implementation.

Information technology and telecommunications:
The NCRPIS staff continues to provide expertise and leadership for the development of GRIN-Global (GG), the successor to the GRIN system; this has become the primary focus of two NCRPIS staff members, with substantial time by additional personnel. This project was undertaken as a partnership between USDA-ARS, Bioversity

International and the Global Crop Diversity Trust (the Trust) to develop a genebank information management system which can be deployed to any genebank in the world. National Program 301 Leader, Peter Bretting, was the PI for this agreement. With the release of GRIN-Global V1.8 to the international community at the start of 2013, efforts were re-focused on gap analysis and programming to address implementation needs of the National Plant Germplasm System (NPGS). Several CGIAR genebanks are in the process of implementing GG 1.9.4, led by CIMMYT. Five other national genebanks have either implemented the system or are in the process of doing so.

The Database Management Unit (DBMU) in Beltsville, MD hosts the GRIN system and has the lead responsibility for NPGS implementation of GRIN-Global. Ames-based development team members include P. Cyr, our Applications Software Development IT Specialist, Project Manager; M. Millard, Maize Curator and Business Analyst; L. Burke, Seed Storage Manager and beta tester; and C. Gardner, RL. Several Ames curators have devoted considerable time to system testing, as have a number of other NPGS genebank site personnel, and provide valuable input on NPGS germplasm community needs. Weekly video training conferences are offered by DBMU personnel for NPGS site personnel participation.

Please see the IT section for technical details of NCRPIS support activities.

Germplasm's Viability and Health:
Six percent of the NCRPIS collections were tested for viability in 2014, significantly more than in recent years as more student labor resources were provided. A germination technical position will be filled in 2015. Our storage conditions (4 C, 25-35% relative humidity) are very good, and the efforts devoted to seed cleaning ensure storage of very clean seed lots, important to longevity of viability. A new field was added in the GRIN-Global System to differentiate simple viability from 'pure live seed.' Dormant seeds that do not readily germinate should be considered in the context of accession viability.

Curator D. Brenner has successfully used concentrated oxygen gas to release seed dormancy of wild *Setaria* species. His team has also tested and adapted a small vibratory deck seed cleaner to improve seed cleaning and reduce time required for cleaning of select taxa.

Horticulturalist D. Barney's section reports research results for germination protocols for *Hypericum* and *Actaea*, and on outcomes of use of various storage regimes for *Calendula*.

Pathology team research (C. Block) focused on combining greenhouse and field resistance screening methods for Sclerotinia stalk rot in wild sunflowers; screening of 3,312 *Cucumis* seedlings grown for presence of Squash Mosaic Virus via ELISA; regular disease monitoring of cucurbit plantings from transplant to harvest and of *Helianthus* plantings for downy mildew, viruses and phytoplasmas; screening of maize for Stewart's wilt resistance and northern corn leaf blight; and testing maize inbreds of known Stewart's wilt response for Goss's wilt resistance. Increased incidence and severity of Goss' wilt of maize has led to intensified research on the biology and epidemiology of this disease. Field observations were made in the increase

plots, and accessions were monitored in particular for diseases for which seed-borne transmission is of concern. A collaborative study of seed infection and transmission of the Goss' wilt pathogen was conducted, needed to assist in phytosanitary considerations and criteria for seed movement. Outcomes are detailed in Dr. Block's section of this report.

Insect management:
The Entomology staff provided six insect pollinator species to control pollinate 765 accessions. Honeybees continue to be the primary pollinator used in the NCRPIS regeneration program, followed by the Alfalfa Leafcutter Bee (ALC).

Detailed, interesting observations and interpretative information regarding their field pollinator research activities can be found in their extensive section of the annual report for information on their continuing efforts to enhance the pollination program's effectiveness and efficiency. Substantial reporting is devoted to this team's activities because of the uniqueness of this project, limited sources of such information, and relevance to the broader germplasm conservation world. Feedback and suggestions on experimental approaches are welcomed.

We continue to consider the impact of the effectiveness of insect pollinators on cross-fertilization of caged plantings, and whether the genetic profile of the accessions is maintained during regeneration.

Enhancement:
The Germplasm Enhancement of Maize Project (GEM) continues to work with public and private collaborators to adapt exotic maize germplasm to broaden the genetic diversity of temperate U.S. maize production and provide unique, key priority traits. Research and breeding are designed to improve exotic germplasm introgression methods, to provide unique sources of allelic diversity, and to identify traits and genes to support improvement of agronomic productivity, disease resistance, insect resistance, and value-added grain characteristics, including total extractable starch to support ethanol production, and resistant starch – of importance to human health and nutrition.

The Ames and Raleigh, NC GEM Projects and public collaborators have released 269 lines from 2001-2014, representing more than 60 maize races. An important goal is development of a set of inbred lines representative of the diversity inherent to all of the races of maize. In addition to traditional introgression methods, the project is generating doubled-haploid maize lines in partnership with the ISU Doubled Haploid Facility to accomplish this objective, and also with collaboration of private sector partners to accomplish the initial increase of doubled-haploid seeds in Hawaii and Chile winter nurseries. USDA-ARS and ISU jointly released 204 doubled haploid lines in 2014; the next set of lines from the allelic diversity project will be released in 2016. These lines have one-quarter exotic, three-quarters temperate background.

Photoperiod sensitive tropical maize often does not flower until September in Ames. GEM and maize curatorial teams have continued to collaboratively develop an effective method for photoperiod control in the field. While successful, it is difficult to achieve the field scale needed to support the number of accessions that require

photoperiod control treatment. The sunflower project has used photoperiod control very effectively to induce flowering in certain wild sunflower accessions. Photoperiod-control environment capacity on the order of one to three acres would be very useful in maintaining and providing unique genetic resources.

Outreach and Scholarship:
Approximately 350 visitors toured the NCRPIS during 2014. Our staff participated in teaching students from grade K to postgraduate level, and provided outreach events to civic and other organizations about germplasm conservation and management, and the work done at the NCRPIS. Scientific and technical staff members continue to publish scholarly journal articles, make presentations at scientific meetings, and supervise graduate research programs.

Current and future foci:
Processes involved in regeneration, characterization, and making viable germplasm available are labor intensive. Resources do not allow maintenance and regeneration efforts, including viability testing, to keep pace with demand. We will continue to try to improve conservation methods to better use the resources available to us, and to develop labor and resource saving technologies. We continue to evaluate activities that can be reasonably reduced without sacrificing collection health and quality, and to improve efficiency.

Continued emphasis will be placed on communicating with research stakeholders to identify and address development of comprehensive, genetically diverse collections to meet research and development needs. Climate change is forcing researchers to renew efforts to identify superior forage cultivars as well, and interest has increased in collections of suitable species. A 'gap analysis' process is utilized to examine distribution of crops and their wild relatives; information sources include herbarium records, floras of various countries and ecoregions, predictive analyses bases on GIS layers and habitat information, and scholarly publications that cite plant sources, traits, and performance attributes. Wise selection of targets is important to managing collection growth and effective use of resources. Horticulturist D. Barney's report details analyses of the herbaceous ornamental collection holdings.

2015 collecting efforts will be targeted to expand native woody ornamentals, especially *Fraxinus* in advance of the destructive Emerald Ash Borer, continuing to preserve individual mother trees from the populations to support genetic research; and *Helianthus*.

Better characterization information is essential to enable well-targeted use of the collections, especially given the increasing constraints of limited research and conservation resources. Availability of PGR significantly impacts research applications, including taxonomy. A recent example is the research of Brigham Young University scientists, who have determined the contributions of two wild species held in NCRPIS collections to the *Chenopodium quinoa* genome.

Pathologist Charles Block's efforts to assess seed transmission of the Goss' wilt pathogen of maize will continue, as will his efforts to develop superior methods to detect seed-borne disease.

Curator Laura Marek will continue to collaborate with *Helianthus* researchers to understand the genetic basis of multiple important traits.

Software development efforts continue to center on the development and deployment of the successor to the GRIN system, GRIN-Global - its schema, internal and public interfaces, and applications for data capture and transfer. These efforts are facilitated by contributions from germplasm stakeholders in the U.S. and abroad, as we seek examples of use cases and desired features and functionalities of the new system. A formal process has been proposed for US and international users to submit enhancement requests, prioritize development, enlist developers, and to securely share new software applications that will extend the system's functions and features.

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

Impacts of germplasm use by the researchers at the NCR institutions:
A detailed list of examples of germplasm use in research being conducted at NCR institutions was not requested of the RTAC members this year. NC7 Region researchers typically account for nearly half of domestic plant germplasm distributions from the NCRPIS. Requests for germplasm continue to increase for research as well as non-research use. Requests become increasingly better targeted as the quantity and quality of information associated with the collection improves, thus sharing of findings resulting from use of NPGS germplasm, linked with the germplasm's identity and source, is critically important.

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

Linkages among project participants and with other projects/agencies and contributions of the Regional Technical Advisory Committee:
Linkages are driven primarily by common research interests and objectives and by the heritage of the germplasm material utilized for research and education. All states utilize germplasm provided by the NCRPIS and many of the other 19 NPGS sites; the states have a complex array of collaborative research efforts between their institutions, and with the plant genetic resource curators at the NPGS sites.

The Regional Technical Advisory Committee (RTAC) has provided valuable direction in the following areas:

- requesting and suggesting organizational structure of information needed to determine project impact and provide accountability. This includes advice on useful formats for analyzing and evaluating the nature of distributions, whom they benefit, and how benefits are realized, which are essential for determining the impact and value of the project.
- identifying needed improvements to the public GRIN interface.

- providing input from their respective AES Directors to curators, genebank and other administrators.
- providing guidance to increase the NCRPIS program's relevance to NCR stakeholders.
- providing technical expertise, particularly in the areas of diversity assessment and taxonomy.
- providing added breadth in understanding issues at genebanks beyond the NCRPIS.
- understanding the challenges faced by public researchers partnering with other public institutions' researchers, both governmental and non-governmental. This has provided useful insights for ARS and NCR administrators to guide programmatic decision-making, as well as operational guidance; this function is key because of its direct impact on the public interest as well as the specific research interests of more directly involved stakeholders.

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

Some of the NC-7 RTAC's specific suggestions and contributions from their 2014 Annual Meeting in Ames, IA include the following: (from the meeting minutes):

- The 2014 RTAC meeting was hosted by Jules Janick and the staff of Purdue University, Indiana, and highlighted the extensive research initiatives related to realizing the value of plant genetic resources for crop improvement. The opportunities afforded by the meetings and field tours are key to establishing the types of collaborative relationships that lead to long-term partnerships for major research and development efforts. Highlights included a truly inspirational presentation by World Food Prize Laureate Gebisa Ejecta, a tour of the University's Horticulture Farm (a world class operation), and Dr. Janick's evening lecture 'Unicorns – Tapestries, Mysteries, History and Horticulture'.
- A warm welcome was extended both by Jules and by new Horticulture Dept. Head Hazel Wetzstein, who provided information on her extensive background and her perspectives on genetic resources and their relevance for agriculture, nutrition, economic development and societal welfare. The value and importance of multistate committees for regional work and strongly endorsed the work of NC7-RTAC was reiterated.
- Jay Akridge, Dean of Agriculture, described initiatives to grow Purdue's agricultural research enterprise.
- The NC7 Committee Members are encouraged by continued increase in demand for accessions by the genetic improvement community, but are concerned over increasing cost for distribution of seed especially for overseas requests and request by the general public some of whom are not research oriented. We proposed that this issue be considered by a select committee composed of RTAC, NCRPIS, CGCs, and USDA program staff.
- The RTAC suggests that a concerted effort be made to track the impact of plant genetic resources on the U.S. agricultural system, and encourages Crop Germplasm Committees to address crop vulnerability statements.

- Consideration should be given to increase internal (within each state) outreach for the Plant Introduction Station.
- The committee thanks Dr. Janick and the Purdue participants for hosting the 2014 meeting; we look forward to the meeting at the North Central Regional Plant Introduction Station in Ames, IA in 2015.

VI. SUPPORT TEAM REPORTS:

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

We supervised and coordinated daily operations at the NCRPIS farm, including management of all facilities, fields, and greenhouse space. We conducted all pesticide applications in the field and campus greenhouses. We responded to maintenance requests from staff members at the farm and the campus location. We selected, coordinated, and scheduled the student labor force of 19.0 FTE's. We coordinated and completed facility construction and upgrades.

Labor:
During 2014, 67 applications for hourly employment were received and reviewed. There were 49 interviews, resulting in 44 new or returning hourly employees hired. Currently there are 16.2 (FTE) Biological Science Aides working at the NCRPIS.

NCRPIS Farm Crew Personnel:
- Larry Lockhart (Program manager II) has been on staff since 1985.
- Lloyd Crim (Equipment Operator III) joined the staff in March 1998. He works half-time for the farm support group and half-time for the oilseeds project.
- Brian Buzzell (Farm Mechanic) joined the staff in May 2002.

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

1. Coordinated replacement of remaining T12 florescent fixture with T8 fixtures and bulbs. Both seed storage rooms are now complete. Coordinated replacement of high bay HPS and Metal Halide fixtures with T-8 multi-bulb high bay fixture in the Maintenance and Entomology shops. Close to 90 percent of all fixtures have now been upgraded to meet new efficiency standards.

2. Greenhouse lighting – Worked with maize project to upgrade greenhouse light fixtures to LED grow lights. We replaced 32 HPS fixtures with LED fixtures in GH3. Early indications are that this is going to reduce electrical usage by 50-60%. There are 32 HPS fixtures in GH3 yet to be replaced. We added four LED fixtures to GH1 and plan to replace the remaining HPS fixtures as funds become available.

3. Repainted headhouse, vernalization facility and bee overwintering/storage garage building.

4. Replaced four windows in the storage garage.

5. Coordinated and planned back-up generator project with area engineers and Iowa State University.

6. Installed Lexan around base of shade houses to protect plants from wind.

7. Installed field tile drainage to Field F to drain wet spot.

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

Equipment Purchased:
- 52 Hp tractor
- Gator Utility Vehicle
- Two flatbed trailers for hauling cage frames
- Closed trailer for use in transporting seed /plants
- Two Percival Germinators
- Zero-turn Mower
- Greenhouse framework to be used as large field cage for Horticulture Project
- Two semi-trailer containers to be used for on-side storage
- External air conditioning units were purchased with USDA funds and installed by ISU personnel to serve the Agronomy greenhouse utilized by NCRPIS personnel.

Tours:
This past year, we organized and conducted 12 tours. There were approximately 350 visitors to the NCRPIS during 2014.

Staff Training:
We conducted Tractor and Utility Vehicle Safety, Worker Right-to-Know and Worker Protection Standard training sessions for the new staff and student employees as well as updates for existing staff.

B. Information Technology and Telecommunications (P. Cyr and J. Perrett)

Jesse Perrett served as the first-line of support for NCRPIS during 2014. Jesse was supervised by Pete Cyr who is assigned to the GRIN-Global project (designed to replace the GRIN Germplasm Management System currently in use). The following list outlines the progress made by the IT team during 2014 at NCRPIS.

Equipment:
As of December 2014, NCRPIS has 59 desktop and 26 laptop/tablet workstations installed for use by permanent staff members and part-time temporary student help. The centralized functions required by the station were supported by 20 physical servers and a number of virtual servers including those used for file storage, intranet, backups, and door security systems.

In 2014, 30 computers were upgraded with solid state drives, and 35 computers were upgraded with new quad core processors and 8 gigabytes of memory. New motherboards were installed in 20 Dell Optiplex 620 computers to upgrade them to use newer technology.

The backup server was upgraded with an external V-Trak array with 16 drives providing over 7 tera-bytes of storage for backup operations. The server KVM system was replaced with an IP KVM which supports up to 32 servers. Two new servers were

built for virtual machines each with 24 drives and 256 gigabytes of memory. The station continues to implement virtual servers wherever possible in order to better utilize existing server capabilities. Multiple virtual machine servers received new solid state drive tiered storage systems utilizing the technology built into Microsoft Windows Server 2012 R2 in order to enhance storage performance of existing servers at minimal cost.

Two separate file servers were moved to one new custom built server in order to take advantage of solid state drive caching and network interface card teaming to enhance network file share performance and take advantage of newer drive technologies.

A new Cisco ASA 5525X firewall was installed and configured in order to provide enhanced security as well as increased network performance in line with the new gigabit network infrastructure.

GRIN Global development continues to be supported by five physical and multiple virtual server systems. The ability to easily and quickly create virtual systems with any operating system and create and restore checkpoints has been invaluable to the development team.

Software:
All workstations at NCRPIS are using Windows 7 or Windows 8.1 except for two workstations which have legacy software or connected lab equipment. The remaining two workstations have Windows XP installed and are not connected to the internet. Microsoft Office 2013, Adobe Acrobat Professional 11, Adobe Creative Suite, Oracle applications for GRIN, and the GRIN Global Curator Tool were installed on systems when necessary.

During 2014 a Symantec Endpoint Protection was decommissioned and Microsoft System Center Endpoint Protection (SCEP) in conjunction with Microsoft System Center Configuration Manager (SCCM) was installed and configured. In addition to facilitating the management of antivirus functionality at the station, SCCM will allow for more control over software deployment and system management for all computers. The station is using Iowa State University SCCM servers which provides the added benefit of ease of management as well as allowing deployment packages for common software installations to be automatically available for use. The Microsoft SharePoint intranet site was upgraded to SharePoint 2013 and also moved to a new Microsoft SQL Server 2012 database server in order to enhance functionality and performance.

Frequent updates to anti-virus and anti-spyware definitions in conjunction with regular full system scans help to ensure that these workstations remain vulnerability free. During 2014 all workstations and servers at NCRPIS received security updates from Microsoft every month via the Iowa State University software update servers. All computer systems on campus and at the farm (servers and workstations) use Microsoft System Center Endpoint Protection for enhanced security against virus and spyware threats.

In order to comply with ARS policy, all compatible laptops were encrypted using bit locker which is built into Windows in order to cut costs. This system uses active directory to store recovery keys and should make encrypted laptop management

easier. Users who need to load images to the GRIN database as well as remote users facilitate connectivity to ARSNet through the use of Junos Pulse software using LincPass access. Remote users are able to gain access both to email as well as secure internal file shares using Cisco Systems VPN client through the Cisco ASA firewall. Active Directory group policies are used to implement the necessary security policies on all machines.

Researched and provided a solution to the DBMU in Beltsville to resolve conflicts between GRIN Oracle Forms and Java updates.

Researched and provided a solution to the ARS OCIO to facilitate implementation of Skype software.

Documentation:
Continuing to support advanced document management and retention via SharePoint Server 2013 Intranet site. The NCRPIS public webpage was redesigned and updated to use a new version of ARS Site Publisher. Posted IT support videos and training documents, and information about farm operation, safety, and health to the NCRPIS intranet website. Provided input to the area IT office regarding system/component information for data calls.

Plans for 2015:
- Install Microsoft Office 2013 on all computers.
- Continue upgrading servers to Windows Server 2012 R2 and implement Windows 8.1 where applicable.
- Decommission old equipment including outdated servers and workstations.
- Continue to replace NCRPIS workstations on an as needed basis (targeting a 3-5 year lifespan for daily use workstations).
- Identify and surplus excess hardware.

GRIN-Global:
The GRIN-Global project is a joint partnership between the USDA-ARS NPGS, the Global Crop Diversity Trust and Bioversity International. The goal of the project is to re-write the current GRIN Germplasm Management System in such a way that it can be deployed on any size computer with a minimum amount of effort and cost. The new Germplasm Management System (dubbed GRIN-Global) will support five different languages, four database systems and install on a single desktop computer or a network. In 2014 the NCRPIS GRIN-Global Development team continued providing enhancements to the curator desktop applications (Curator Tool). The most notable enhancements include: modifications that make order processing (via the Order Wizard) easier including loading attachments to the order for import permits and inspections (via the Attachment Wizard), added friendly pop-up messages to provide the user with details about what they are viewing on the screen, added barcode enabled labels to the Curator Tool for one-step creation of jar and field labels, various enhancements to the Search Tool in order to assist curators in finding accessions of importance. Provided enhancements to the database schema to fully support viability testing data and created a new Viability Wizard to automate the data entry during the viability testing process.

C. Information Management-Germplasm Collections (R. Stebbins)

Acquisition:
The North Central Regional Plant Introduction Station (NCRPIS) acquired 766 new accessions in 2014. Of these new accessions, 506 were received from within the National Plant Germplasm System (NPGS) through exploration and transfer. This included 346 accessions from the Seeds of Success program.

The remaining 262 accessions received from outside the NPGS included 59 accessions of *Setaria* from the Donald Danforth Plant Science Center in Missouri and 41 accessions of *Helianthus* donated by Chase Mason at the University of Georgia.

As new accessions are recorded in the Germplasm Resources Information Network (GRIN) database, we include as much passport information as possible. Typical passport information would include a source history, cooperator records, collection-site description and geographic coordinates for wild collections, pedigree, secondary identifiers, and any other pertinent information provided by the donor.

Maintenance:
Curatorial assistance was provided by processing requests for taxonomic re-identifications and nominations of accessions to the inactive file. In total, 32 accessions received taxonomic re-identifications. Among these were seven accessions of ornamental species and five accessions of *Melilotus*. Also, 133 accessions were nominated for inactivation, including 43 accessions of *Helianthus*, 30 accessions of ornamental species, and 26 accessions of crucifer species. Eight accessions were inactivated due to duplication including seven accessions of *Amaranthus*. The inventory lots of these accessions were integrated together with lots of their respective duplicates.

Additionally, 221 accessions were assigned PI numbers. Included in this group were 220 accessions of *Helianthus*.

Conclusions:
Compared to 2013, 571 more new accessions were received at the NCRPIS in 2014. Among the maintenance areas, one fewer re-identification was made, 118 more nominations were made to the inactive file, PI-number assignments were 52 greater, and six more duplications were resolved than in the previous year. The number of new accessions acquired and the totals for re-identifications, nominations to the inactive file, and PI number assignments were below their 19-year averages. Resolved duplications were also below its 16-year average.

D. Order processing (R. Stebbins)

During 2014, 2,574 orders were entered into GRIN, the highest number of orders ever initiated in one year. These orders led to the external distribution of 42,763 items (primarily seed packets, but also vegetative samples). Of these, 24,021 items (56%) were distributed within the United States, and 18,742 (44%) were sent to foreign requestors. Additionally, 7,200 items were distributed within the NCRPIS, for germination, observation, regeneration, and disease testing. Finally, 1,422 items

were sent to the National Center for Germplasm Resources Preservation (NCGRP) for backup.

The number of orders entered into GRIN in 2014 was 284 more than that of 2013 (a new record for the NCRPIS); also, the number of items distributed outside the NPGS was up by 1,111. The number of requests received electronically this year was 2,196, an increase of 135 from 2013.

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

Two full-time, permanent federal employees (Lisa Burke and Lisa Pfiffner), and three part-time students staffed the seed storage area. Lisa Pfiffner continued to serve as the federal supervisor for several of the crews led by state employees.

In 2014, we stored 1,857 inventory lots, including 846 original seed lots. Of the original lots stored, 240 were woody landscape accessions, along with 169 *Helianthus* and 146 *Zea*. Of the increase lots, 700 Ames increases and 235 non-Ames increases were stored. Of all stored lots, 816 lots had sufficient seed quantities to be made available for distribution. We split 27 original lots to make them available for distribution in limited quantities. We reviewed 3,695 inventory lots for seed quantity, and any discrepancies were corrected in the GRIN database. Four hundred and eighty-six samples were prepared and transferred to the -20C freezer for long-term storage.

We filled 1,338 seed orders in 2014, including those for distribution, observation, germination, transfer and backup. NCRPIS distributed 43,536 packets to meet distribution and observation requests. There were 675 lots sent to the National Center for Genetic Resources Preservation (NCGRP) for backup, involving both accessions new to NCGRP and additional seed quantities for previously deposited accessions. We transferred 44 inventory lots to other NPGS sites (all lots were woody landscape genera).

2014 saw the continuation of the prepacking program. With the aid of our student workers, we pre-packed 44,437 packets of 4,589 inventory lots. Prepacking impacts seed storage operations by keeping the on hand inventories more accurate and speeding up seed order filling. Pre-packing also reduces the need for count reviewing because distribution lots are continually monitored and only count reviewed when order activity is high for a given accession. This year we focused on getting the entire cultivated sunflower collection pre-packed.

NCRPIS continued to participate in sending seed to the Svalbard Global Seed Vault in 2014, by preparing 747 accessions for backup there. Sample amounts ranged from 200 to 800 seeds depending on the amount of seed needed for two regenerations. For inventory tracking purposes, an inventory action code (SVALBARD) was added to GRIN for all lots shipped. Packets were filled and orders sent to NCGRP for preparation and shipment to Svalbard.

Seed storage personnel continued to maintain the germplasm distribution display in the farm headquarters hallway. New maps were printed at the start of 2014, and destinations for both domestic and international shipments were marked. The maps

are a stop on tours of the station and show visitors both national and international destinations of our germplasm orders.

Scanning of original seed samples continues. In 2014, 168 scans were taken, mostly of original samples. Some imaged samples were new to the station while others were being pulled for regeneration when the entire sample was needed. Creating a visual reference of seed lots that have been used up for planting is an important tool to allow future comparisons with the increase lots by curators and storage personnel.

Lisa Burke continued to participate in the development of GRIN Global.

Lisa Pfiffner completed the AOSA Germination Analyst certification.

With the departure of Maria Erickson, the station's germination technician, Lisa Pfiffner has continued to assume responsibility for aspects of the seed germination program. She handles testing of newly regenerated seed lots and special testing for regeneration purposes. Both activities are key in storing regeneration seed lots and aiding curators in regenerating seed lots. This year she also included maintenance germination testing. She spends approximately half of her work time in the germination area.

Lisa Burke continued as the station's CPR/AED/First Aid instructor. She provided three-year First Aid certification for 28 NCRPIS student workers and two-year CPR/AED/First Aid certification for 9 staff members. Included in the First Aid classes were two interns and two student workers from campus. Each session was entered into the National Safety Council database and certificates of completion provided for each participant. Cooperative work with campus staff on improving the CPR/AED/First Aid training was continued.

Additional focus was given to analyzing space constraints in all the cold rooms including the -20 freezer. With spacing getting tight, we have reviewed material that could be either repackaged/relocated for space efficiency or discarded due to samples no longer being needed for research. Also, shelving configuration rearrangement was completed in the amaranth and cuphea area to allow for storage of more pint sized jars.

F. Germination (L. Pfiffner)

In 2014, the germination lab completed germination or TZ testing on 141 orders containing 2,508 accessions.

Type of Order	# Orders	# Accessions
Regeneration/Other	104	991
Maintenance	21	1457
TZ	16	60

Advances were made in maintenance testing of the following crops, *Amaranthus* 143 accessions tested, *Cucumis* 501 accessions tested and *Zea mays* 928 accessions tested.

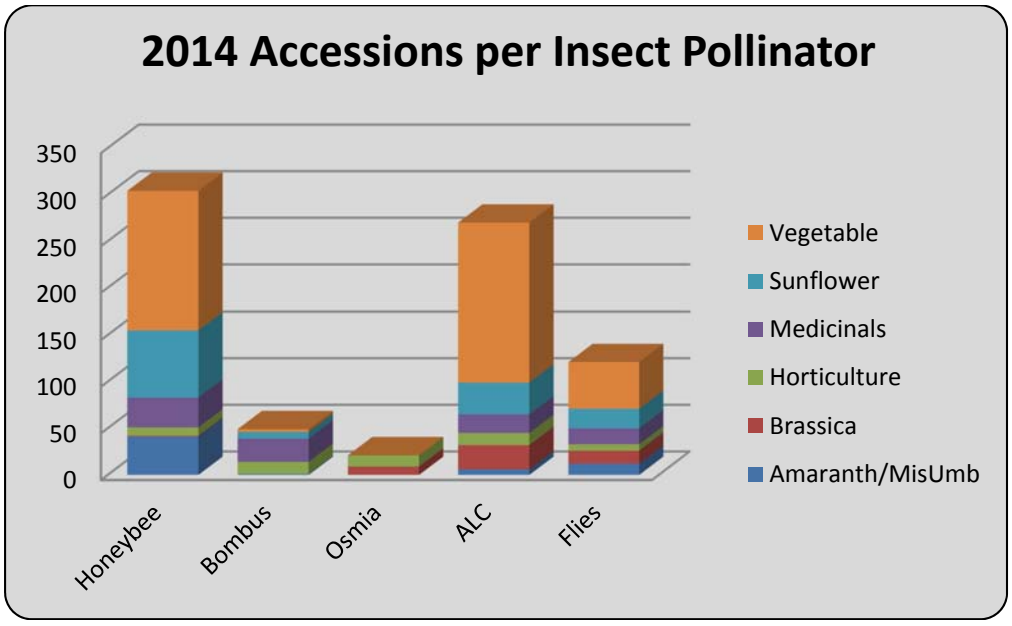
The species *Amaranthus dubius* was investigated with a maintenance germ and TZ testing of the remaining ungerminated seeds of 42 accessions. This was done to better understand the storage capacity of this species.

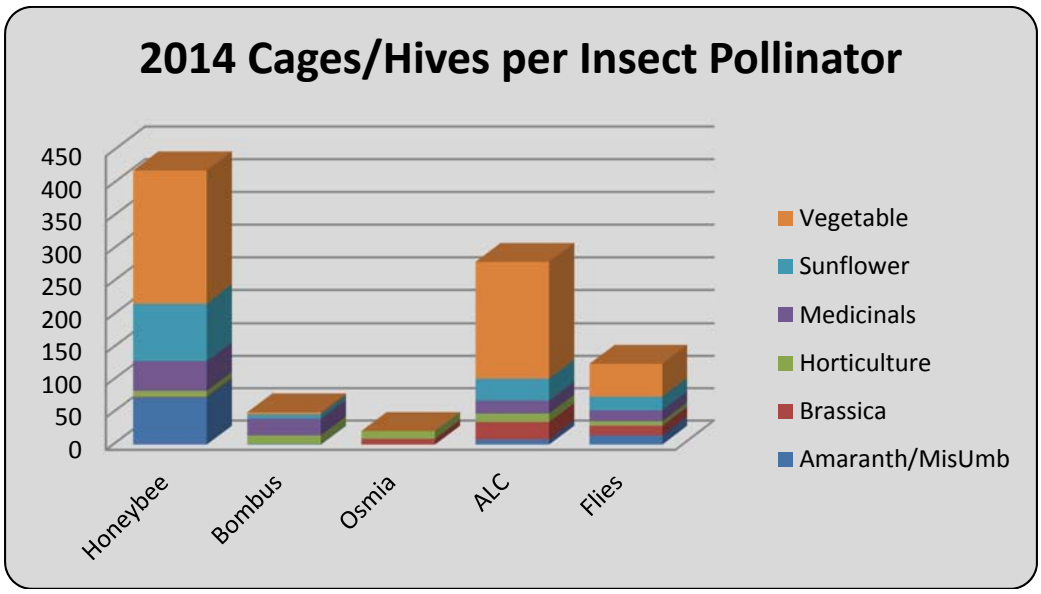
VII. CURATORIAL AND SCIENTIFIC TEAM REPORTS

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

Summary of Pollinators supplied to 2014 regeneration cages

Number of Unique ACCESSIONS per pollinator						
	Honeybee	***Bombus***	***Osmia***	**ALC**	**Flies**	**TOTAL**
Amaranth/MisUmb	41	1	0	6	12	60
Brassica	1	0	9	26	14	50
Horticulture	9	13	12	13	7	54
Medicinals	32	25	0	20	17	94
Sunflower	72	7	0	34	21	134
Vegetable	149	3	0	171	50	373
OVERALL	304	49	21	270	121	765
Number of TOTAL CAGE/HIVES per pollinator						
	Honeybee	***Bombus***	***Osmia***	**ALC**	**Flies**	**TOTAL**
Amaranth/MisUmb	73	1	0	8	14	96
Brassica	1	0	9	27	15	52
Horticulture	9	13	12	13	7	54
Medicinals	46	26	0	20	17	109
Sunflower	88	7	0	34	21	150
Vegetable	203	3	0	178	51	435
OVERALL	420	50	21	280	125	896





Progress:

Caged pollination:

Bee pollinators (minus the alfalfa leafcutting bee) were supplied a single time to 491 cages for controlled pollination of 374 accessions. Alfalfa leafcutting bee and fly-pollinated cage numbers are tabulated and reported separately due to multiple distributions of those insects to the same cages over the pollination season.

Honey bee pollination:

Honey bees were used to pollinate 304 accessions in the field.

2014 Honeybee Pollinator Deliveries to Regeneration Cages

Crop Group	Total # of Accessions	# of Genera	# of Accessions/Genera
Misc.Umbels	41	5	29 *Melilotus*, 4 *Petroselinum*, 3 *Ammi*, 3 *Coriandrum*, 2 *Anethum*,
Brassica/ Sunflower	1/72	1/2	65 *Helianthus,* 7 *Euphorbia*, 1 *Crambe*
Horticulture/ Medicinals	9/32	4/6	14 *Baptisia*, 13 *Calendula*, 6 *Spiraea*, 2 *Matricaria*, 1 *Actaea*, 1 Cornical Cherry, 1 *Cornus*, 1 *Dasiphora*, 1 *Euonymus*, 1 *Potentilla*
Vegetable	149	4	101 *Cucumis*, 33 *Daucus*, 9 *Cucurbita* (2 nucs/cage), 6 *Ocimum*
Total	**304**	**22**	

Overwintering success: 88% of the 33 three story parent colonies, 58% of the 69 two story parent colonies and 7% of the 29 double-story nucleus colonies stored in the 2013 indoor wintering facility survived, comparable to the 94%, 91% and 40% from 2012.

No colonies were left outside during the winter 2013, all colonies and nucleus hives were placed into the overwintering facility. We removed all colonies and nucs from the room starting on March 13, 2014. In the winter of 2014, we placed in the

overwintering room 43 three story parent colonies, 1 two story parent colonies and 31 double story nucleus hives.

We purchased 20 "Buckfast" 3-pound packages to supplement over-winter losses and 50 "Buckfast" queens to supply spring nucs used for cage pollinations. The packages were placed into full size hives and given three feedings of high fructose corn syrup and two pollen treatment. The majority of the queens were placed into nucleus boxes with two frames of brood and a single frame of honey and adhering bees. Some of the queens were used to replace failing queens in parent colonies.

In Early-May we selected queens from resilient, over-wintered parent colonies to produce queens for nucleus hives during summer 2014 and set them up in cell builder colonies. We started grafting queens on May 19 and produced an average of 20 queens per week with our final cell production being the best of the season at 42. Nucleus hives were produced until the first week of August. Nucs which were not used in cages for pollination were fed, an additional super placed on top and strengthened for over-wintering.

In August, all medium-strength single story nucleus hives containing three to four frames of bees had an additional super placed on top to prepare them for over-wintering. Based on the past two years over-wintering survival, it was decided to leave all parent colonies as three stories to possibly improve hive numbers in the spring. Because of the November "polar vortex", approximately 75% of the double story nucleus hives did not survive to be placed indoors. However, parent colony mortality was found to be much lower at approximately 33%.

In June, July and August, 20 colonies at three locations were sampled twice a month using the powdered sugar roll method. This study was a continuation of the "screen bottom board comparison study" done by Joaneette Oliveras Rivira in 2013. The highest mite population during this time was 12 mites/100 bees with the majority of the colonies having less than 10 mites/100 bees (see ARS Photo by Scott Bauer). Even though mite counts were lower than documented economic injury levels (EIL), in September all hives were treated with formic acid (Mite-Away quick strips) to possible improve over-wintering of hives. After treatment was removed and prior to hives being placed into the overwinter facility, hives were not sampled to determine whether mite populations were reduced.

All parent colonies and nucleus hives were given three treatments of Fumagilin – B® in April 2014 for the prevention of dysentery (nosema). In October, all hives were prepared for over-wintering and were given three medicated feedings of Fumagilin – B®. In July and August, all parent colonies and double story nucs received three treatments of Terra-Pro (Terramycin). This treatment was based on recommendations from the State Apiarist and the observance of European Foul Brood (EFB) in several colonies. In the past two years, we have given a fall treatment of Tylan to all hives; Tylan controls American Foul Brood (AFB), but has little control on EFB.

For wax moth control during the summer, supers with stored frames were stacked at right angles to each other to prevent adult moth migration. Starting in July through

November, the lights in the equipment room were left on during working hours (8 hours; five days). All equipment removed from the field as "dead hives" was stored in the overwintering room at a temperature of 60° F. and at right angles to each other. The moths in the dead equipment were not eliminated, but were kept confined to one or two supers and limited damage. Starting in July, some damage was observed in stored supers; however it was limited to supers in the center of several stacks and not throughout the stacks.

We continue to use our syrup feeding system of a 1,050 gallon polypropylene tank, a 30 gallon poly "mixing" tank and a dish washer for cleaning feeding containers. To prevent crystallizing of the high fructose corn syrup (HFCS) in the large interior storage tank, the contents were circulated for at least five minutes daily. Additional HFCS was purchased for the supplement feeding of bees during the summer and into the spring of 2015. New syrup was not received until the end of June, which caused several fields of caged nucs not to be fed for two weeks; however it did not appear to affect pollination in the cage. In the spring and fall, once feed containers were placed on hives in the field, syrup was transported using five gallon buckets and containers were refilled in the field. This prevented container and syrup loss during transport.

All bee locations were re-registered with the Iowa Department of Agriculture and Land Stewardship (IDALS). The IDALS registry assists pesticide applicators in locating bee-yards and in obtaining contact information of appropriate beekeepers prior to spraying.

In August, all hives were removed from one location because of rising water and chance of flooding. At an additional location at this same time hives were not able to be removed and flooding occurred, however water levels only reached half way up the side of the bottom box and minimal damage occurred. The summer of 2014 was the final use for one of the ISU location as a bee-yard as it will be sold in 2015. With the loss of this yard and flooding issues the past three years at two other locations, it will be necessary during the winter of 2015 to contact ISU and private land owners to obtain at least two new replacement locations.

<u>Bombus pollination</u>:
Twenty-two "mini-research" colonies of *Bombus impatiens* were purchased from a commercial supplier and used to pollinate 50 field cages with 49 accessions. A single *Bombus* hive can be used for pollinating more than one cage with a minimum lapse of 48 hours between sites to prevent pollen contamination.

2014 *Bombus* Pollinator Deliveries to Regeneration Cages

Crop Group	Total # of Accessions	# of Genera	# of Accessions/Genera
Misc.Umbels	1	1	1 *Melilotus*
Sunflower	7	1	7 *Helianthus*
Horticulture/ Medicinals	13/25	4/5	14 *Baptisia*, 8 *Staphylea*, 6 *Actaea*, 3 *Calendula*, 3 *Caragana*, 1 *Cercis*, 1 *Dasiphora*, 1 *Maackia*, 1 *Potentilla*
Vegetable	3	1	3 *Cucurbita* (2 hives/cage)
Total	**49**	**12**	

We continued to use 60-quart protective plastic containers or affixed two full supers to house the cardboard *Bombus* hives while in field cages. The protective shelter and hive are placed on a honey bee hive body and lid for a stand and with the plastic container two water-filled quart containers are placed inside as weights to prevent the wind from blowing the container and hive off of the stand.

<u>*Osmia cornifrons*/*O. lignaria* pollination</u>:
Osmia were used to pollinate a total of 21 field cages with 21 accessions.

2014 *Osmia* Bee Pollinator Deliveries to Regeneration Cages

Crop Group	# of Cages	Total # of Accessions	# of Genera	# of Accessions/ Genera
Brassica	9	9	1	9 *Brassica*
Horticulture	12	12	1	12 *Aronia*
Total	**21**	**21**	**2**	

In the 2013 growing season, we obtained an increase of ca. 719 *Osmia* pupae (36 domiciles at 20 bees/domicile) which could be used for pollination and increase during the 2014 pollination season. We purchased an additional 1000 commercial cells in the spring of 2014 from a supplier.

The pupae were used to fill 48 two-inch domiciles and 15 three-inch domiciles. The two inch domiciles were divided in the following manner, 21 were used in pollination cages and 27 were used at "increase" sites. All of the three inch domiciles were placed at a single "increase" site in 2014. The Precision® incubator which was used for storage of all straws and domiciles in 2014 had to be defrosted twice during the year and bees had to be relocated for 24 hours in comparable incubators. The minor break in diapauses did not appear to affect the emergence of adult bees or pollination.

We collected ca. 181 pupae from domiciles in 2014 for use in the spring of 2015. We will also try to obtain additional pupae for cage requests and increase in 2015.

Through the use of a GPS unit and Google-Earth, we tracked and plotted the 42 "increase" domiciles which were placed at two locations for retrieval later in the summer. The 15 three inch domiciles where placed in three apple orchards and the 27 two-inch domiciles were placed on the boundaries of a field of buckwheat and a cherry orchard.

<u>Alfalfa leafcutting bee (ALC) *Megachile rotundata*</u>:
ALC bees were purchased as larvae in leaf cells from a single supplier for use in 2014, arriving in Ames, IA on January 23, 2014. The bee cells were held in refrigerated storage until scheduled for placement in warm incubation and bee emergence boxes. Bees were available weekly throughout the

year for use in plant regeneration cages in the field and greenhouse from mid-November 2013 through mid-November 2014. Because of early greenhouse pollination needs in November 2014 and the termination of the 2014 pupae supply, the 2015 ALC cocoons were received on November 10, 2014.

In 2014, 1791 total ALC deliveries were made to a total of twelve fields and three greenhouses with 280 cages containing 270 accessions. Six greenhouse cages of *Cucumis* are still undergoing pollination at the transition from 2014 into 2015.

2014 Alfalfa Leafcutter Pollinator Deliveries to Regeneration Cages

Crop Group	# of Deliveries	# of Cages	# of Locations	# of Accessions	# of Genera	Time Period
Misc.Umbels	32	8	2	6	4	March – June
Brassica/ Sunflower	230/115	27/34	3/3	26/34	5/2	Feb. – Oct. July – Nov.
Horticulture/ Medicinal	35/32	13/20	3/2	13/20	2/5	May – June May – Oct.
Vegetables	1347	178	5	171	3	Nov (13). – Sept.
Total	**1791**	**280**	**18**	**270**	**21**	**Nov. (13) – Nov.**

Numbers of active ALC-supplied cages and frequency of bee delivery vary seasonally and by cage structure/location and individual accession characteristics. In normal pollination situations, ALC bees/cells are only provided to crops in the summertime. However at the station, ALC are used outside of the normal time frame. From November 2013 through November 2014, greenhouse cages were supplied weekly with bees. 2014 field requests for ALC bees started in early-May and the number of weekly active cage increased rapidly through mid-August and then declined with the final field cages being supplied through early November.

In 2014 we received U.S. sourced cells, which have more parasites and parasitoids than found in Canadian cells. Based on the need for additional storage trays and refrigerated storage, the supplier did ship an additional amount of pupae for pollination use. In 2014, the new Precision® incubator was used for storage of screen trays of cocoons from January to August. This was the same incubator used for the storage of osmia straws and domiciles in 2014 and was defrosted twice during the year. As with the osmia, the screen trays were relocated for 24 hours but there was no observable decline in the immergence of adult bees.

In early November, because of caged greenhouse plants having no bloom and a weekly supply of emerged bees, ALC were placed into several late blooming *Helianthus* field cages even though pollination needs had ended.

<u>Flies (Blue Bottle Flies and Houseflies)</u>:

Fly pupae of two species (Calliphoridae and *Musca domestica*) were purchased from two suppliers and incubated for weekly use from February 2014 through December 2014 for greenhouse and field pollinations. From June through August, twenty-six orders of 10,000 house fly pupae were purchased and from February through

September 248 cups of blue bottle fly pupae were purchased. In 2014, 695 fly deliveries were made to nine fields and three greenhouses with 125 cages containing 121 accessions representing 18 genera.

An average of 12 greenhouse cages received flies weekly from February 2014 through the beginning of July 2014. Five greenhouse cages of *Cucumis* and *Daucus* are still undergoing pollination at the transition from 2014 into 2015. In the field from June through mid-October an average of 28 cages received flies weekly.

2014 Fly Pollinator Deliveries to Regeneration Cages

Crop Group	# of Deliveries	# of Cages	# of Locations	# of Accessions	# of Genera	Time Period
Misc.Umbels	104	14	1	12	4	June – Aug.
Brassica/ Sunflower	73/49	15/21	5/2	14/21	4/2	March – Oct. Sept. – Nov.
Horticulture/ Medicinal	15/24	7/17	2/2	7/17	2/4	May – Aug. May – Oct.
Vegetables	430	51	3	50	2	Feb. – Sept.
Total	**695**	**125**	**15**	**121**	**18**	**Feb. – Nov.**

Only blue bottle flies were distributed weekly in winter and spring greenhouse cages due to blue bottle flies working at cooler temperatures and a large number of cage requests in the cooler greenhouse. Both blue bottle flies and houseflies were distributed weekly to summer field cages. Re-supplying flies weekly to cages ensures continued pollinator presence. If appropriate and available, bee pollinators may be present in the same cages receiving flies.

Tests:

Screened Bottom Board Comparison Study:

Literature states that screen bottom boards are a good mechanical control for *Varroa* mites. The mites once dislodged from the adult honey bee fall through the screen to the ground beneath the hive and are unable to crawl back and reattach to a bee and parish. In June and July of 2013, Joaneette Oliveras Rivira a George Washington Carver intern did an initial comparison study using 9 screened bottom boards on three colonies of bees at three different bee yards and compared their mite populations to those of nine colonies on solid bottom boards. In 2014, this study was repeated using a total of 20 colonies on screened bottom boards set at three locations. Colonies were sampled twice a month through the months of June, July and August using the powdered sugar roll method. The same screen bottom colonies were sampled each time; however not all of the same solid bottom colonies were sampled every time. As in 2013, no difference was observed between colonies on a screened bottom board and colonies on a solid bottom board based on total mites per 200 bees. It was observed that the reduced sampling done in 2014 caused less stress to the colonies based on more stable bee populations and less aggressiveness. This method will not replace the use of miticides which are needed during times of increased mite populations, but it is an additional method of mite control which can be used during normal seasons.

Prevention of distribution of summer wax moth:
As in 2013, all "dead" or removed equipment from the field was placed into the over-winter room. Early in the season, all removed equipment was taken apart and the supers stacked at right angles to each other. Later in the season, removed equipment was not torn down and just stacked in the room. In 2013, there was a buildup of moisture in the intake air pipe, so in 2014, the intake fans were turned off for the summer and the temperature was raised to 60° F. These changes seemed to keep moth populations under control. However in the month of July the air conditioning stop working for approximately two weeks and there was an outbreak of both larval and adult moths which occurred due to the increased room temperature. Once the unit was repaired and the room was again cooled all infestation by larvae and adults slowed down and was contained. This storage method does prevent moth outbreaks and frame damage in the entomology building and keeps frame moth numbers at a minimum, so we will continue to use this summer storage method in the future.

Safety:
First Aid/CPR:
On August 26, S. Hanlin participated in First Aid/CPR training which is requirement of all permanent staff every three years.

Chemical Inventory:
On January 15, S. Hanlin updated the Entomology chemical inventory including obtaining updated MSDS for new mite treatment chemicals.

Defensive Driving:
Because of the amount of time that the bee crew is off the station and the amount of cumulative miles during the summer, annual driving training is needed to refresh good driving habits. On March 26, S. Hanlin completed "Defensive Driving Fundamentals" and on April 1, S. Hanlin completed "Defensive Driving" on AgLearn.

Epi-Pens:
In March based on recommendations from ISU Occupational Medicine, S. Hanlin with the assistance of S. Siev established a new web training link for recognizing the signs of anaphylactic shock and the correct use of Epi-pens and created "completion documentation" for permanent staff. Four replacement pens were obtained in August and expired pens were returned to Occupational Medicine. The new pens will not expire until January 2016 and will not be replaced until the spring of 2016. All staff are required to do annual web training in the spring of 2015. The Epi-pens are available at NCRPIS for emergency use to prevent anaphylactic shock caused by bee stings or other allergic reactions.

Presentations and Outreach:
On January 6 through 11, S. Hanlin gave an invited presentation in Baton Rouge LA to speak at the American Beekeeping Federation's (ABF) annual meeting. The presentation was focused on the various pollinators which are used at the station, how they are obtained and the crops they are used to pollinate. An overview of the NPGS and NCRPIS was also included in the presentation for background knowledge.

On January 22, S. Hanlin spoke to J. Crow (Stratford GH) about use of flies for tomato pollination. In the past the greenhouse has used *Bombus*, but was looking for a more

economical method of pollination. Crow was informed that for greenhouse tomatoes that Bombus use is her best option and that flies are inadequate as pollinators.

On February 5, S. Hanlin met with R. Palmer and R. Hessel to visit about hive and management costs for honey bee pollination. This information was included in a Grant Proposal which was being submitted by Palmer for a future soybean study. In July, eight large ALC domiciles were loaned E. Kaschke (Post Doc for Palmer) to be used in Kansas for housing bees being used to pollinate male sterile lines of soybeans.

In March, S. Hanlin met with A. Dolezal (ISU Post – Doc. Amy Toth lab) to discuss obtaining weekly both ALC and *Osmia* bees for a lab study in which honey bee diseases were introduced to solitary bees. The study was to determine if honey bee diseases could cause decline in native pollinators or if native pollinators could be carriers of honey bee diseases and transmit the diseases to honey bees. Starting in March through May, Dolezal obtained approximately 100 ALC bees every two weeks for his experiment. No *Osmia* bees were used in 2014 for this experiment. On two occasions in July, ten extra queen cells were given to the "Toth Honey Bee unit" to be used for the production of nucleus hives.

On May 15, G. Doolittle (Biological Science Aid) and S. Hanlin spoke to seven groups of sixth grade students on honey bees and beekeeping at the Squirrel Hollow Outdoor Classroom held in Jefferson IA.

S. Hanlin assisted curatorial staff with Pocket Pollinator issues including setting up 2014 imbedded workbooks for several curators and end of the year curator summaries of total pollinators use per project. These data are entered into GRIN.

Plans for 2015:

Winter feeding of OW bees:

In the past, many of the overwintered nucleus hives have been alive in January/early February, and by March when they are removed from the indoor storage facility, appear to have starved to death. A possible explanation is that the smaller hive cannot store adequate food source during the fall for survival of the hive throughout the winter. A possible solution is to offer a winter feed patty containing carbohydrates and limited proteins which the hive can feed on until a pollen patty and syrup source can be fed to them in the spring. This feed is sold by several bee supply vendors to assist with winter survival of over-wintered colonies. Possible questions to address include whether extra food will increase nuc survival, and whether these supplements that are designed for feeding hives being wintered outdoors will work on hives being stored indoors and not promote nosema (dysentery of honey bees). In 2015 a limited supply of patties will be purchased in late January to be applied to approximately half of the nuc hives and some colonies starting in February and continued until hive removal in the spring. All surviving hives will be observed to determine whether the winter feeding assisted in survival and strengthening of the hive and is there any sign of nosema in the hives.

Building stronger screen bottom boards:

In 2014 all screen bottom boards worked well as a non-chemical control for *Varroa* mites. However, the 20 commercial made screen bottom boards were found to be less durable because of weak joints and a lack of center support for hand cart use. These

weaknesses were not an issue if the colony did not need to be relocated during the summer, however if the colony needed to be moved it first had to be set on a solid bottom board so that the hand cart could be used to load/unload the colony. In the winter of 2015, the joints on the purchased screen bottom boards will be secured using either nails or screws and a center board attached as a hand cart platform support. If these improvements work during the summer of 2015, this will be the model for building additional bottom boards in the winter of 2016. One of the issues that will have to be checked during the summer is to make sure that the center brace does not give too much protection to mites and thus contribute to re-infestation of the hive.

Personnel resources:
The Agricultural Science Res. Technician position has been vacant since October, 2011, and Mr. Hanlin has been assisted since then exclusively by temporary student employees. The position was held open because of impending closures at other locations and the need to hold vacant positions for technicians who may want to accept a relocation assignment. This condition has been lifted and we hope to refill this position in 2015

B. Plant Pathology (C. Block)

Personnel changes:
Bill Van Roekel, longtime plant pathology technician retired in Jan-2014, and the year was spent without technical support other than part-time student help.

Disease Resistance Evaluations:
Sclerotinia wilt resistance in wild sunflower (*Helianthus* spp.):
Sclerotinia wilt resistance screening focused on 15 previously untested perennial species (159 accessions) plus five accessions from the newly identified annual species *Helianthus winteri*. The *H. winteri* accessions showed a modest level of resistance, but were not notably better than the resistance found in many annual species. A total of 1073 accessions across 14 annual and 37 perennial *Helianthus* species have been evaluated over the time frame of this screening project. Our long-time collaborator, Dr. Thomas Gulya from USDA-ARS, Fargo, ND retired in 2014.

2014 Stewart's wilt resistance screening in maize:
Stewart's wilt disease resistance evaluations of maize inbred accessions were conducted on 157 maize inbreds. Entries included an approximately 50:50 mix of previously untested germplasm and once-tested PVPs. Plants were inoculated at ~V6 growth stage and again one week later at ~V8 with a mixture of three isolates of *Pantoea stewartii subsp. stewartii*. Accessions were rated on a 1-9 scale with 1.0 being nearly immune and 9.0 being highly susceptible. Disease development was slower than normally seen because of the cooler weather but finished with generally good expression. We were able to identify and/or confirm several highly-resistant accessions. The five most resistant accessions, led by PI 601689 (WIL500), are shown in Table 1. The three most susceptible accessions included a check inbred, Ames 20140 (Mt42) which averaged 8.9 and two Connecticut sweet corn inbreds Ames 26812 (C3) and Ames 26813 (C5) which both averaged 9.0, or completely killed.

Table 1. Stewart's wilt resistance of top-performing maize accessions in 2014

Entry	**Alternate ID**	**Other notes**	**2014 SW average score (1.0 to 9.0 scale of R to S)**
PI 601689	WIL500	Developed by Wilson Hybrids from tropical germplasm population.	1.0 (retest, same score in 2012 and 2013)
PI 591015	BO394Y	South African inbred	1.1; first time tested
CIze 81	CI 81B	Strain from (H893 x CI 19)	1.1 (retest, 1.1 score in 2013)
PI 531085	NC262	Developed in North Carolina	1.1 (retest, 1.2 score in 2013)
Ames 27185	Pa875	Developed in Pennsylvania	1.2 (retest, 1.0 score in 2013)

Goss's wilt seed infection and seed transmission Studies:
We continued a second year study with A. Robertson and L. Shepherd on Goss's wilt seed infection and seed transmission. Several seed lots were planted in a 5-acre field at plant populations of 35-36,000 plants per acre. The seed lots ranged from 2.5% to 9% *Clavibacter michiganensis* subsp. *nebraskensis* (*Cmn*)-infected seed. The field was scouted twice a week from planting until tassel emergence. One case of seed transmission was found among 178,000 plants. When the transmission rate was recalculated to consider only the infected seed fraction, the seed transmission rate was about one per 10,000 infected seeds. This was significantly lower than the 2013 frequency of about one time per 2000 infected seeds. The 2013 seed lots contained much higher percentages of seed infection overall, up to 31% infected seed and as a result, more severely-infected (i.e. shrunken, shriveled) kernels. Such kernels may be prone to a higher frequency of seed transmission.

To follow up, we designed a seed conditioning experiment with Alan Gaul from the ISU Seed Science Center. The strategy was to subdivide an initial seed lot into multiple fractions based on a standard seed conditioning protocol similar to that used by a commercial seed company. Seed samples were plated onto selective agar media to assess the percentage of kernels from each fraction that were carrying viable *Cmn* bacteria. Seed infection percentages were reduced in the conditioning process, but *Cmn*-infected seeds were not completely eliminated. Notably higher percentages of infected kernels were found in the small and light seed fractions.

Disease Observations on Seed Increase Crops:
Plant health monitoring continued with field inspections of seed parent plants for maize (curation and GEM), sunflowers, and cucurbits:

Maize:
During August and the first two or three days of September (post-flowering) I inspected 307 seed increase plots (maize curation) for diseases, recording both presence and relative disease severity. Plots were inspected for gray leaf spot, Stewart's wilt, Goss's wilt, northern and southern corn leaf blight, eyespot, crazy top, common rust, common smut, head smut, sorghum downy mildew and wheat streak mosaic virus. Similarly, 616 GEM entries were inspected for the same diseases. In

terms of typical diseases of phytosanitary concern for export, none were found – no Stewart's wilt, Goss's wilt, crazy top or other downy mildew diseases, head smut, or southern corn leaf blight were observed. The last time Stewart's wilt was found at the Station was in 2007.

Sunflower:
Multiple field inspections of sunflower were carried out for downy mildew, viruses, and phytoplasmas. No downy mildew (the main phytosanitary issue) was present and no other unusual disease problems were observed.

Cucurbits:
Routine disease testing for squash mosaic virus was conducted on all cucurbit seedlings prior to transplanting. One hundred and four accessions with 3,246 plants were sampled. No SqMV-infected plants were identified by ELISA. The seedling screening combined with cage screening was successful in keeping SqMV out of the field planting. The SqMV test results are summarized in Table 2. Field plantings were scouted every 2-3 weeks to monitor disease development. Powdery mildew continues to be a frequent problem in the field and regular fungicide spraying is required to manage mildew.

Table 2: Squash mosaic virus testing results for 2014

Species	**Accessions tested**	**Accessions with infected plants**	**Plants tested**	**# of SqMV infected plants**
Cucumis spp. (melo, sativus)	104	0	3031	0
Cucurbita pepo	9	0	215	0
Total	**113**	**0**	**3246**	**0**

Seed Health Testing/Seed Treatment:
We carry out a seed health testing and fungicide seed treatment program to support international seed shipments – 452 laboratory tests were run, 408 for maize and 44 for sunflower. Phytosanitary documentation, i.e. freedom from specific pathogens, was provided to support seed shipments for 102 international seed orders

Meetings attended:
National Sunflower Association research forum and the Sunflower Crop Germplasm Committee meeting, Fargo, ND (Jan. 7-9, 2014).

ASTA Vegetable and Flower seed conference, Monterey, CA (Jan 24-28, 2014).
Participated in a special session on phytosanitary issues and international movement of vegetable seeds. Post-meeting visits to Sakata Seed in Salinas and STA Labs in Gilroy, CA.

American Phytopathological Society annual meeting, Minneapolis, MN (Aug 10-14, 2014).

ASTA Corn and Soybean research conference, Chicago, IL (Dec 8-12, 2014). Participated in a special session on phytosanitary issues and the plant pathologists' meeting.

Publications:
Reitsma, K.R., C.C. Block and L.D. Clark. 2014. Cucurbit Germplasm Collections at the North Central Regional Plant Introduction Station. Proc. Cucurbitaceae 2014, October 12–16, 2014, Bay Harbor, Michigan, USA. pp. 125-128.

Markell, S. G., Harveson, R. M., Block C.C., and Gulya, T. J. (Book Chapter) Sunflower Diseases. In Sunflower: Chemistry, Production, Processing and Utilization. Martínez-Force, E., Dunford, N. T., Salas, J. J., Eds.; AOCS Press: Urbana, IL. In press. pp. 93-128.

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

Acquisition and inactivation:
We acquired 82 new accessions, including 1 *Amaranthus,* 8 Apiaceae, 1 *Chenopodium*, 1 *Dysphania*, 2 *Glyceria*, 1 *Gomphrena*, 2 *Panicum*, 63 *Setaria*, 1 *Portulaca,* and 2 *Spinacia.* Seven accessions were inactivated due to duplication.

Ilia State University in the Republic of Georgia donated four landrace millet accessions, two *Panicum miliaceum* and two *Setaria italica.* We are regenerating them at NCRPIS under special permit from APHIS, which will allow greater control of the first seed increase.

A research network based at the Donald Danforth Plant Science Center in Saint Louis, Missouri donated 59 *Setaria* accessions representing wild-collected samples from the United States. Some research results using these is already published (Huang et al. 2014, Layton and Kellogg, 2014). These accessions are to be a focus of research activity at multiple locations, and NC7 is to distribute the seeds until their 500 seed critical distribution levels are reached without being obligated to regenerate seeds.

The Institute of Botany in Yerevan, Armenia donated two wild spinach *Spinacia tetrandra* accessions.

The Bureau of Land Management, Seeds of Success (SOS) program donated 17 accessions requested by NC7 through the Western Regional Plant Introduction Station (WRPIS) in Pullman, Washington. All accessions were wild-collected and native in the United States, and included:

- *Amaranthus fimbriatus.*
- *Angelica*, *Eryngium*, and *Polytaenia.*
  - These taxa have ornamental potential.
- *Chenopodium desiccatum*.
- *Dysphania graveolens*
  - This species is new to our collection, and is used medicinally and as a spice.
- *Glyceria.*
  - Of interest to anthropologists as traditional wild-gathered foods and for re-vegetation.

- *Gomphrena nitida*
  - Donated by the SOS and the Lady Bird Johnson Wildflower Center.
  - An important ornamental with a small *ex situ* germplasm collection.
- *Setaria leucopila* and *S. scheelei*
  - *Setaria scheelei* is a new taxa in our collection).
- *Portulaca halimoides*
  - A new taxa in our collection.

Maintenance:

Availability:

The overall availability for these crops improved slightly from 87% to 88% (Appendix Table 1). In the spring of 2015 our seed cleaning and processing activities were essentially up-to-date through the fall of 2014, except for 62 *Melilotus* seed lots which are to be cleaned in mid-2015.

Chenopodium:

Accession availability improved from 79 to 82 % with the storing of 52 increased seed lots. We plan to store an additional 22 seed lots in the spring of 2015.

Millets and other grasses:

Our millet plants in the greenhouse are typically impaired by iron chlorosis, and treated with a ferric citrate solution. A new protocol uses top-dressing with 0.5 cm of sterilized field soil, has eliminated the iron chlorosis problem and replaced the ferric citrate treatment.

Melilotus:

We transplanted *Melilotus* and parsley into field SF-2 on April 11, 2014, and they survived a cold snap down to -4.4 °C (24 °F) on April 15 without damage. Prior to field planting, the seedlings were hardened in a 4 °C short-day growth chamber. Heavy rain and aphids reduced plant growth, but harvests were adequate. For the first time since 2009, we will not have a *Melilotus* field season in 2015.

Miscellaneous Apiaceae:

Most *Petroselinum* transplants suffered wet field conditions during 2014. Ten accessions of *Petroselinum* were planted in July 2014 for transplanting into the field and harvesting in 2015.

An accession of *Bifora radians* (Ames 5009) performed well in our winter greenhouse where it is well adapted. We had *Bifora* seedlings germinate in December 2014, eleven months after planting, which is typical of winter-annual germination.

Perilla:

Three *Perilla* accessions were regenerated in 2014. We are gradually replacing all the *Perilla* seed lots since they have relatively short storage lives. Under our 4°C storage conditions their seed viability is generally too low for distribution after 20 years.

Spinacia:

Two wild spinach accessions were regenerated in our Ames facilities, and two more were planted for harvesting in 2015. We stored 28 seed lots regenerated in Salinas CA during the winter of 2014. The inventory is current enough, (98 % available) that

we did not request seed regeneration by our cooperators in Salinas, CA during the 2014-2015 season.

Viability testing:
A total of 425 accessions (5% of our collections) were assayed for viability in 2014, an increase from 3% in 2012.

Amaranthus dubius:
Viability for 7 distribution seed lots of *Amaranthus dubius* fell to about 0%. The inviable seed lots were 21 to 27 years old. Similar-aged seed lots of *A. dubius* are still viable, with normal seedlings near 100%. Tetrazolium testing by Lisa Pfiffner and Julio Ramirez (a student employee) was used to distinguish dormant and inviable seeds. Without TZ testing, these seed lots were classified as more than 90% dormant in about their tenth year. Why some seed lots aged poorly remains unknown. Cryogenic-stored seeds of the same accessions were grown out at NC7 and performed well in greenhouse plantings. All 7 accessions were regenerated for seed increase in 2014.

Amaranthus dubius seed lots exhibiting viability loss in storage

Accession	Seed lot	Original viability & year	Viability in 2014	Viability of 2014 regenerated seed lots
Ames 5674	87ncai01	85% 1988	0%	100%
Ames 19996	93ncai01	75% 1993	0%	98%
PI 532151	90ncai01	90% 1991	0%	100%
PI 536438	90ncai01	89% 1991	0%	99%
PI 536441	90ncai01	94% 1991	1%	99%
PI 536444	90ncai01	92% 1991	2%	100%
PI 572254	87ncai02	94% 1987	0%	98%

GRIN database management:
We continued to update passport data in 2014 with the addition of 103 secondary identifiers, and 72 accession actions entered in GRIN. Most of this entry was part of an effort to prepare *Coriandrum* and *Amaranthus* accessions for eventual PI number assignment. No new PI numbers were assigned in these crops in 2014.

In 2014, 623 accession citations of 35 publications were loaded in GRIN, for a total of 2,446 citations for our crops. This information is available on public GRIN

Characterization/evaluation/taxonomy:
Amaranthus:
Luis Turriza planted *Amaranthus cruentus* experimentally as a winter crop in Campeche, Mexico. Four accessions were adapted to short day lengths and able to grow there (PI 538255, PI 477913, PI 662284, PI 667164). This is interesting, since previously in Campeche amaranths were only grown during the summer long-day season.

A recent study of 27 of our accessions (Andini et al., 2013) measured foliage protein level and protein quality. The lysine levels are high, 5 to 7% of the protein, resulting in protein quality that is good in comparison with animal derived protein, or with that

of amaranth grain. The foliage is also protein rich, 12 to 29% protein on a dry-weight basis. Amaranth foliage is a good source of protein and can therefore be promoted as a food to alleviate protein deficiency, besides containing vitamins and minerals.

A planting of the distribution seed lots of 150 accessions of the African Vegetable type *Amaranthus cruentus* collection and other black seeded *A. cruentus* was started in the Agronomy greenhouse on the ISU campus. The objectives in making this planting are to resolve issues of duplication, characterization, taxonomy, and purity of the accessions, and to produce data for the morphological group descriptors. During these grow-outs in 2014, six accessions were found to be contaminated by weed species and will be regenerated to produce purer seedlots. In most cases they appear to have been contaminated by weed pollen during field regenerations.

Blitum nuttallianum:
In 2014 we observed that *Blitum nuttalinum* is adapted as a winter annual in Ames, Iowa. In the winter of 2014-2015 it was grown in our greenhouse that is kept cool and has no supplemental lighting, where it did well, and seems better adapted than in our warmer greenhouse.

Minor grasses:
A descriptor for vegetative structure such as bunchgrass or spreading by rhizome, was added to the Grasses-Minor NC7 research crop. It is the same descriptor already in use for the millet genera.

Portulaca:
Two accessions (PI 532152 and Ames 31285) were re-identified from *Portulaca oleracea* to *Portulaca oleracea* subsp. *sativa*. Sub-species sativa is cultivated in the mid-east for food and forage, it is more erect and larger seeded than the wild type. It may be useful as an introduction for use in other arid regions.

Taxonomy:
In 2014, David Brenner made 16 taxonomic re-identifications, involving eight genera. In addition, two existing taxonomic determinations were confirmed with entries in GRIN's annotation area. Accession PI 633593 was changed from *Amaranthus palmeri* to *Amaranthus watsonii* during a routine regeneration. This change makes PI 633593 the only *Amaranthus watsonii* accession in the NC7 collection and increases the known diversity of the *Amaranthus* collection by one species.

An accession of *Margotia gummifera* (Ames 30292) was re-identified as *Rouya polygama* after international online consultation with Fernando Martínez Flores in Spain, and others. Kathleen Reitsma was instrumental in this re-identification which is important because it involves the carrot relatives.

Research products publications and presentations:
David Brenner, Lisa Pfiffner, and coauthors studied the effects of concentrated oxygen gas on releasing seed dormancy of wild *Setaria* species. Our seed samples were enclosed in plastic Ziploc® bags. We inflated the bags with a medical oxygen concentrator of a type that is intended for home use, and sealed the bags for the duration of our eight-day study. Germination increased by about 100% over control samples. The project was written up and then accepted as a 2015 publication in Crop

Science. This dormancy releasing method with concentrated oxygen is also applicable to other species.

In an effort to reduce time and labor spent cleaning small seeds, David Brenner tested a small, vibratory deck seed cleaner borrowed from the Iowa State University Seed Science Center (Figure 2). Prior to tests at NCRPIS, the seed cleaner was refurbished by NCRPIS staff members Larry Lockhart and Brian Buzzell. Machines that work on the similar principle are presently in use at NPGS units W6 and Parlier, CA. We found that the seed cleaner worked well with selected taxa, reducing the time spent picking debris out of seed lots. Plans are to request purchasing a similar seed cleaner for NC7.

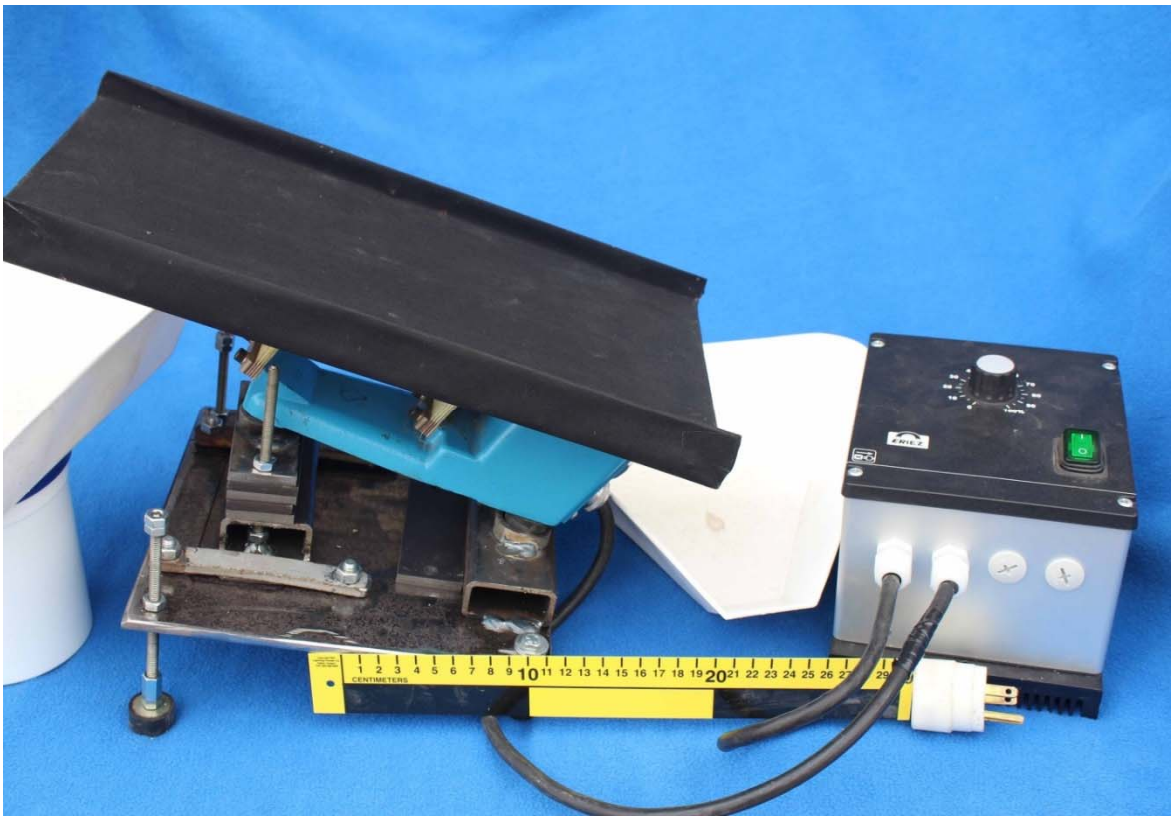


Figure 2. A vibratory deck seed cleaner was borrowed from the Iowa State University Seed Science Center and refurbished for tests at NCRPIS.

Gomphrena nealleyi (PI 658757) seeds are difficult to clean because they are covered with cottony fibers. Samuel Flomo devised two new ways to clean them. He placed the seeds inside a stack of round, tightly fitting sieves and blew compressed air through the screens, causing the seeds to whirl around and removing the fibers. Additionally, Samuel Flomo and Jesse Worth utilized hooked Velcro® to pull fibers off of the seeds.

Manuscript Review:
David Brenner reviewed four manuscripts for external organizations.

China:
David Brenner presented a talk: Quinoa Germplasm Maintenance, at the National Gene bank of the Chinese Academy of Agricultural Sciences (CAAS) in Beijing, China,

September 9, 2014. The talk was part of a small conference organized for a new multi-location quinoa project in China using germplasm from our collection.

Crop Germplasm Committee reports:
Written progress reports were prepared for the Clover and Special Purpose Legumes, Forage and Turf Grass, Leafy Vegetable, and New Crops, Medicinal and Essential Oils Crop Germplasm Committees (CGCs). David Brenner was the recording secretary for the grass and clover CGCs.

Operations Manual:
We contributed six re-written appendices for the new operations manual. They describe our methods for cultivating plants for germplasm regeneration.

GRIN-Global development:
We participated in the development of GRIN Global by participating in weekly GRIN-Global tele-conferences. The Programmers used some of our suggestions for improving GRIN features.

Staff training and development:
David Brenner spent one week China, which included travel to quinoa research plots of the Hangzhou Academy of Agricultural Sciences (HAAS). David was able to see, but not taste, culinary fleshy-root-amaranth in Hangzhou. The plants were *Amaranthus tricolor* of the tiger-eye morphological group that appears to already be in the NC7 germplasm collection. Knowing now what to look for, we will try to determine whether fleshy rooted accessions are included in our germplasm collection.

Culinary fleshy-root amaranth in China.

David Brenner took a short course in specialty seed conditioning at the Iowa State University Seed Science Center.

Conclusions and Plans for 2015:
We will have a field that is new to us in 2015 for a 3 to 4 year cycle. In 2015, we will begin longer-term plantings of *Angelica*, *Eryngium,* and *Galega*, which generally flower in their second and third field seasons. The amaranth field planting will include comparison of old and new seed lots of plant breeding selections.

We will expand experimentation with dormancy breaking protocols for highly dormant seeds of wild species.

After the recent installation of improved campus greenhouse swamp coolers, we plan to utilize the Agronomy greenhouse more during the summer of 2015. The work will include August observation-plantings of *Amaranthus hybridus* and *Amaranthus quitensis* from South America to review taxonomic determinations.

David Brenner plans to present a talk on the amaranth germplasm collection at the Amaranth Institute meeting, and a poster on the use of concentrated oxygen to release seed dormancy at the American Society of Agronomy meeting.

Selected research publications derived from use of NC7 germplasm or associated information:
Akin-Idowu, P.E., Odunola, O.A., Gbadegesin, M.A., Oke, A., and Orkpeh, U. 2013. Assessment of the protein quality of twenty nine grain amaranth (Amaranthus spp. L.) accessions using amino acid analysis and one-dimensional electrophoresis. African Journal of Biotechnology. 12:1802-1810. doi: 10.5897/AJB12.2971.

Brenner, D.M., Dekker, J., Niemi, J., and Pfiffner, L. 2015. Medical oxygen concentrators for releasing seed dormancy. Crop Science. In Press.

Casini, P. and La Roca, F. 2014. *Amaranthus cruentus* L. is suitable for cultivation in Central Italy: field evaluation and response to plant densities. Italian Journal of Agronomy. 9:166-175.

Andini, R., Yoshida, S., and Ohsawa, R. 2013. Variation in protein content and amino acids in the leaves of grain, vegetable, and weedy types of amaranths. Agronomy. 3:391-403. doi: 10.3390/agronomy3020391.

Huang, P., Feldman, M., Schroder, S., Bahri, B.A., Diao, X., Zhi, H., Estep, M., Baxter, I., Devos, K., and Kellogg, E.A. 2014. Population genetics of *Setaria viridis*, a new model system. Molecular Ecology. 23:4912-4925. doi: 10.1111/mec.12907.

Kietlinski, K.D., Jimenez, F., Jellen, E.N., Maughan, P.J., Smith, S.M., and Pratt, D.B. 2014. Relationships between the weedy *Amaranthus hybridus* (Amaranthaceae) and the grain amaranths. Crop Science. 54:220-228. doi: 10.2135/cropsci2013.03.0173.

Layton, D.J. and Kellogg, E.A. 2014. Morphological, phylogenetic, and ecological, diversity of the new model species *Setaria viridis* (Poaceae: Paniceae) and its close relatives. American Journal of Botany. 101:539-557.

Out, W.A., Grau, J.F., and Madella, M. 2014. A new method for morphometric analysis of opal phytoliths from plants. Microscopy and Microanalysis. 20:1876-1877. doi: 10.1017/S1431927614013270.

Stefunova, V., Bezo, M., Labajova, M., and Senkova, S. 2014. Genetic analysis of three *Amaranth* species using ISSR markers. Emirates Journal of Food and Agriculture 26:35-43. doi: 10.9755/ejfa.v26i1.15911.

Research indirectly related to our germplasm:

Achigan-Dako, E.G., Sogbohossou, O.E.D., and Maundu, P. 2014. Current knowledge on *Amaranthus* spp.: research avenues for improved nutritional value and yield in leafy amaranths in sub-Saharan Africa. Euphytica. 197:303-317.

Dohm, J.C., Minoche, A.E., Holtgrawe, D., Capella-Gutierrez, S., Zakrzewski, F., Tafer, H., Rupp, O., Sorensen, T.R., Stracke, R., Reinhardt, R., Goesmann, A., Kraft, T., Schulz, B., Stadler, P.F., Schmidt, T., Gabaldon, T., Lehrach, H., Weisshaar, B., Himmelbauer, H. 2014. The genome of the recently domesticated crop plant sugar beet (*Beta vulgaris*). Nature. 505:546-549. doi: 10.1038/nature12817.

Escobedo-Lopez, D., Nunez-Colin, C.A., and Espitia-Rangel, E. 2014. Adaptation of cultivated amaranth (*Amaranthus* spp.) and their wild relatives in Mexico. Journal of Crop Improvement. 28:203-213.

Groota, P.C., deGroota, L., Kodde, J., and van Treuren, R. 2014. Prolonging the longevity of *ex situ* conserved seeds by storage under anoxia. Plant Genetic Resources Characterization and Utilization. 13:18-26. doi: 10.1017/S1479262114000586.

Ribeiro, D.N., Pan, Z., Duke, S.O., Nandula, V.K, Baldwin, B.S., Shaw, D.R., and Dayan, F.E. 2014. Involvement of facultative apomixes in inheritance of EPSPS gene amplification in glyphosate-resistant *Amaranthus palmeri*. Planta. 239:199-212.

Sunil, M., Hariharan, A.K., Nayak, S., Gupta, S., Nambisan, S.R., Gupta, R.P., Panda, B., Choudhary, B., and Srinivasan, S. 2014. The draft genome and transcriptome of *Amaranthus hypochondriacus*: A C4 dicot producing high-lysine edible pseudo-cereal. DNA Research. 21:1-18. doi: 10.1093/dnares/dsu021.

D. Horticulture (D. Barney, J. Carstens)

The horticulture program continued with two main foci during 2014. Jeff Carstens continued as curator working with the NC7-woody landscape collection with an emphasis on *Aronia* regeneration and evaluation, and *Fraxinus* and *Gymnocladus* acquisition. Dan Barney continued as curator of the NC7-medicinals, mints, and herbaceous ornamentals collections. His areas of focus were to develop management plans for high- and medium-priority taxa and accessions, and to prepare the *Baptisia* collection for transfer to the Ornamental Plant Germplasm Center in Ohio.

Table 1. Taxa with active accessions maintained in the NC7 horticulture collections as of December 31, 2014.

Management group	Genera	Subgeneric taxa	Accessions
NC7-medicinals	10	94	504
NC7-mints	16	50	209
NC7-ornamentals	68	316	1008
NC7-woody landscape	95	383	1839
Total	**189**	**843**	**3560**

Acquisitions:
During 2014, we added 17 medicinal, 37 mint, 199 herbaceous ornamental, and 137 woody landscape accessions to the horticulture collections.

Most of the new accessions for the medicinals, mints, and herbaceous ornamentals collections represent germplasm collected by the Bureau of Land management as part of the Seeds of Success program. Accessions representing 4 genera and 7 subgeneric taxa were added to the medicinals collection, 5 genera and 9 subgeneric taxa to the mints collection, and 15 genera and 65 subgeneric taxa to the herbaceous ornamentals collection.

Collection trips were completed by Jeff Carstens in Iowa, Missouri, Arkansas, Alabama, and Mississippi. New accessions acquired focused on *Fraxinus, Diervilla, Spiraea, Betula,* and *Gymnocladus.* Additional collections acquired through collaboration included *Fraxinus* (Kang Wang, Botanical Institute of the Chinese Academy; Kevin Conrad, Woody Landscape Crop Germplasm Repository; Richard Olsen, Woody Landscape Crop Germplasm Repository; Martin Scanlon, Woody Landscape Crop Germplasm Repository; and Joseph Zeleznik, North Dakota State University), *Cornus* (Bryan Peterson, University of Maine; and Endrit Kullaj, Agricultural University of Tirana), and *Euonymus* (Andy Schmitz, The Brenton Arboretum; and Lael Neal, Polk County Iowa Conservation).

Maintenance:
New plantings of 13 *Calendula*, 18 *Echinacea*, 3 *Matricaria*, 13 *Monarda*, and one *Origanum* accessions were made for the medicinals, mints, or herbaceous ornamentals collections during 2014 in field N1. All of those accessions were planted for seed increase purposes except for 8 *Echinacea* accessions that were planted only for use as part of a joint research project between the NCRPIS and the University of Louisiana Monroe. Ten of the *Echinacea* accessions planted will be used both for seed increase and the research project. In addition to the newly-planted accessions, harvests continued on already established *Actaea* and *Baptisia* accessions in field G and one *Dasiphora* accession in field N4.

A.

B.

Figure 1. A) The NCRPIS Horticulture crew cultivates a *Calendula* cage and spreads shredded paper mulch to control weeds. B) A *Calendula officinalis* accession grown for seed increase and taxonomic confirmation for requesting a PI number.

Maintenance efforts for woody-landscape accessions continued in 2014 with 34 accessions transplanted for future regeneration. New plantings focused on accessions of *Spiraea, Diervilla, Cornus, Fraxinus,* and *Ulmus.*

Availability and Backup:
At the end of 2014, approximately 73% of the medicinals collection was available, unchanged from 2013. For the mints and herbaceous ornamentals collections, 65% and 52% of the accessions were available, respectively, compared to 73% and 63% in 2013. The apparent decrease in availability was due to the receipt of a large number of accessions that were still pending storage at the end of 2014 and were not yet available for distribution. For the woody landscape collection, 51% of the accessions were available, an increase of approximately 2% from the year before.

For the medicinals and mints accessions, 79% and 85%, respectively, were backed up as of the end of 2014, while 73% percent of the ornamentals and 42% of the woody landscape accessions were backed up. Data on the NC7 horticulture collections accessions, and their availability and backup status are shown in Table 2, below, and Appendix Tables.

Table 2. Availability and backup status of NC7 horticulture collections for 2014.

	Accessions			
	High priority	**Medium priority**	**Low priority**	**Total**
NC7-medicinals				
No. of accs	298	107	99	504
backed up	257 (86%)	90 (84%)	51 (52%)	398 (79%)
available	252 (85%)	69 (64%)	48 (48%)	369 (73%)
NC7-mints				
No. of accs	71	53	85	209
backed up	58 (82%)	52 (98%)	68 (80%)	178 (85%)
available	53 (75%)	51 (96%)	31 (36%)	135 (65%)
NC7-ornamentals				
No. of accs	84	277	647	1008
backed up	74 (88%)	249 (90%)	409 (63%)	732 (73%)
available	66 (79%)	177 (64%)	314 (49%)	524 (52%)
Totals	**453**	**437**	**831**	**1721**
backed up	**389 (86%)**	**391 (89%)**	**528 (64%)**	**1308 (76%)**
available	**371 (82%)**	**297 (68%)**	**393 (47%)**	**1028 (60%)**
NC7-woody landscape				
No. of accs	1839	N/A	N/A	N/A
backed up	766 (42%)	N/A	N/A	N/A
available	938 (51%)	N/A	N/A	N/A

Regeneration:
Regeneration efforts in 2014 included seed production from established, caged shrubs and herbaceous ornamentals, as well as new field plantings.

For the NC7 woody landscape collection, we made a total of 39 harvests from *Aronia, Staphylea, Betula, Maackia, Cornus,* and other miscellaneous taxa. We attempted to establish 66 accessions including *Betula, Aronia, Spiraea* and other miscellaneous taxa.

For the NC7- medicinals, mints, and ornamentals collections, we made a total of 42 harvests from *Actaea*, *Anemone*, *Baptisia*, *Calendula*, *Glebionis*, *Dasiphora*, *Matricaria*, *Prunella*, and *Thalictrum*. As detailed in the previous section, we established new container or field plantings for *Echinacea*, *Monarda*, and *Origanum* for harvests in 2015 and beyond. And will carry over existing plantings of *Actaea* and *Prunella* for 2015 harvests.

Viability Testing:
A total of 114 seed viability assessments were made for the woody landscape accessions, 18 for the medicinals, 8 for the mints, and 66 for the herbaceous ornamentals.

Distribution:
Distribution figures for the horticulture collections are summarized in Table 3 and 4, below, and Appendix Tables. For the combined horticulture program, we distributed 154 external domestic and foreign orders to 134 requestors totaling 590 items from 421 accessions. We cancelled 308 orders from 292 requestors representing 791 items. Most of the orders were cancelled because they were requested for home gardening or other non-research use.

Table 3. Taxa most in demand from the NC7 horticulture program during 2014 in terms of the number of items requested and the number of items actually distributed.

Taxa	**Most requested (greatest to least)**	**Most distributed (greatest to least)**
Medicinals	*Prunella vulgaris*	*Echinacea purpurea*
	Echinacea purpurea	*Prunella vulgaris*
	E. angustifolia var. angustifolia	*Echinacea pallida*
	E. pallida	*Echinacea angustifolia* var. *angustifolia*
	Hypericum perforatum	*Echinacea angustifolia* var. *strigosa*
Mints	*Origanum vulgare*	*Origanum vulgare*
	Origanum vulgare subsp. *vulgare*	*Origanum vulgare* subsp. *vulgare*
	Monarda citriodora var. *austromontana*	*Monarda fistulosa*
	Monarda fistulosa	*Agastache foeniculum*
	Monarda hybr.	*Agastache urticifolia*
Ornamentals	*Calendula officinalis*	*Glebionis coronaria*
	Matricaria chamomilla	*Calendula officinalis*
	Glebionis coronaria	*Lavatera thuringiaca*
	Lavatera thuringiaca	*Thalictrum dasycarpum*
	Dasiphora fruticosa subsp. *fruticosa*	*Dasiphora fruticosa* subsp. *fruticosa*
Woody landscape	*Fraxinus quadrangulata*	*Fraxinus quadrangulata*
	Gymnocladus dioicus	*Cornus mas*
	Cornus mas	*Hippophae rhamnoides*
	Hippophae rhamnoides	*Gymnocladus dioicus*
	Viburnum bitchiuense	*Betula nigra*

Table 4. External domestic and foreign germplasm distributions for the NCRPIS horticulture program during 2014.

Crop	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accs Distributed
Medicinals	2010	35	31	165	129
	2011	47	45	125	91
	2012	32	29	166	97
	2013	31	30	150	94
	2014	21	18	133	87
	Average	33.2	30.6	147.8	99.6
Mints	2010	22	22	54	34
	2011	34	32	125	79
	2012	29	29	81	58
	2013	30	30	150	87
	2014	19	18	44	35
	Average	26.8	26.2	90.8	58.6
Ornamentals *	2010	82	73	301	248
	2011	114	95	599	405
	2012	49	48	106	86
	2013	45	41	190	154
	2014	41	40	186	160
	Average	66.2	59.4	276.4	210.6
Woody Landscape	2012	47	43	166	131
	2013	76	63	265	186
	2014	73	58	230	139
	Average	65.3	54.7	220.3	152.0

* For 2010-2011, herbaceous ornamental and woody landscape plants were reported as a single group. Beginning in 2012, the collections were split into two separate maintenance groups. Decreased distributions in 2014 partially reflect changes in NC7 policy regarding distribution of seeds for non-research and non-educational purposes, and do not necessarily indicate decreased demand for the germplasm.

Characterization/taxonomy:
During 2014, 22 *Baptisia* accessions were renamed due to changes in accepted taxonomy for the genus or reidentification. All *Actaea* and *Baptisia* accessions in the field were evaluated to confirm identities and photographs were taken to serve as voucher specimens. Preparations began to request PI numbers for these accessions. Loading the images onto GRIN is pending implementation of GRIN Global.

During 2014, 4 woody landscape accessions were renamed based on morphological characteristics.

Evaluation:
Descriptor lists for *Actaea*, *Hypericum*, and *Prunella* were developed at NC7 and approved by the Medicinal and Essential oils Crop Germplasm Committee (MEOCGC). Descriptor lists for *Monarda*, *Origanum*, and *Potentilla* were developed

and are pending submission to the MEOCGC and Herbaceous Ornamentals Crop Germplasm Committee (HOCGC) for approval.

In 2014, a total of 1097 observations were collected on woody landscape accessions and were loaded into GRIN. Observations focused on *Aronia*, *Fraxinus*, and *Gymnocladus*, and included total soluble solids, fruit diameters, fruit weights, USDA Cold Hardiness Ratings, Omernik Ecoregions, leaf area index ratings, seed widths, seed lengths, peak flowering, and ploidy level. A large portion of the observations obtained included oil and fatty acid analysis completed by Terry A. Isbell, at USDA-ARS-NCAUR located in Peoria, Illinois.

Enhancement:
No enhancement activities were conducted on the NC7-medicinals, mints, or ornamentals collections in 2014.

A small, long-term project to conduct recurrent selection on *Fraxinus ornus* (flowering ash) for improved winter survival was terminated. The winter of 2013-2014 resulted in complete dieback to ground level. Due to unanticipated results and the introduction of the Emerald Ash Borer, plans are to remove plants completely in 2015.

Specimens originating from a population of *Quercus prinoides*, Ames 23752, were selected for extreme prostrate growth habits and superior fall color in 2013. Out of 65 specimens represented in this population, 22 individuals were selected for regeneration in 2014. Currently, there are approximately 300 specimens growing in the greenhouse for future evaluation and further selection.

Coordination of the NC-7 Regional Ornamental Trials:
In 2014, Jeff Carstens distributed 71 plants of two accessions to 14 sites for long-term evaluation.

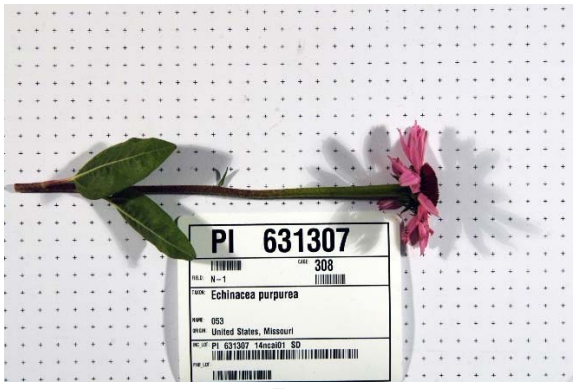
Research products:
Dan Barney continued trials on *Calendula officinalis* seed storage that began in 2007. Seeds from three accessions harvested in 2007 were stored either at room temperature (about 22 ^{o}C) or 5 ^{o}C and were germinated either with or without light. After 72 months in storage, seeds stored at room temperature germinated at significantly higher percentages than seeds stored at 5 ^{o}C. Seeds germinated at higher percentages in the dark than in the light. These results have been consistent across multiple evaluations over the six-year period. Sufficient seeds remain to continue the trials at 10-year intervals for an additional 50 years.

Figure 2. In a long-term experiment, *Calendula officinalis* seeds are being stored at room temperature or 5 °C and are germinated either in the dark or light. Data has been collected periodically between 2008 and 2013 and the trials may continue for another 50 years.

Other research and training activities:
Research continued on seed viability assessments, dormancy, and seed development. Focus areas for 2014 included cold stratification of *Actaea* seeds and the effects of desiccation and storage temperatures on *Hypericum* seeds.

In 2014, we established 18 *Echinacea* accessions in containers and in field N1 for a joint research project with the University of Louisiana Monroe looking at improved methodologies for extracting bioactive compounds related to stimulation of bone marrow production. During 2014, we harvested flower stalks and leaves from *Echinacea angustifolium*, *E. angustifolium* var. *angustifolium*, *E. pallida*, and *E. purpurea* for analysis by ULM. We obtained a one-year no-cost extension on the ARS germplasm evaluation grant to allow the project to continue through September 2015.

A.



B.

Figure 3. In a collaborative research project between the NCRPIS and the University of Louisiana Monroe, *Echinacea* plants were grown in containers A) and the field during 2014 to provide leaves and flower stalks B) for analysis and development of extraction procedures for medicinal compounds.

During 2014, Dan Barney worked to develop and refine methodologies for producing high-definition close-up images of seeds, insects, and other small specimens using flatbed scanning, macrophotography, and microphotography. A how-to guide is being prepared for release in early 2015, with hands-on workshops on the imaging methods planned for NCRPIS and Iowa State University personnel.

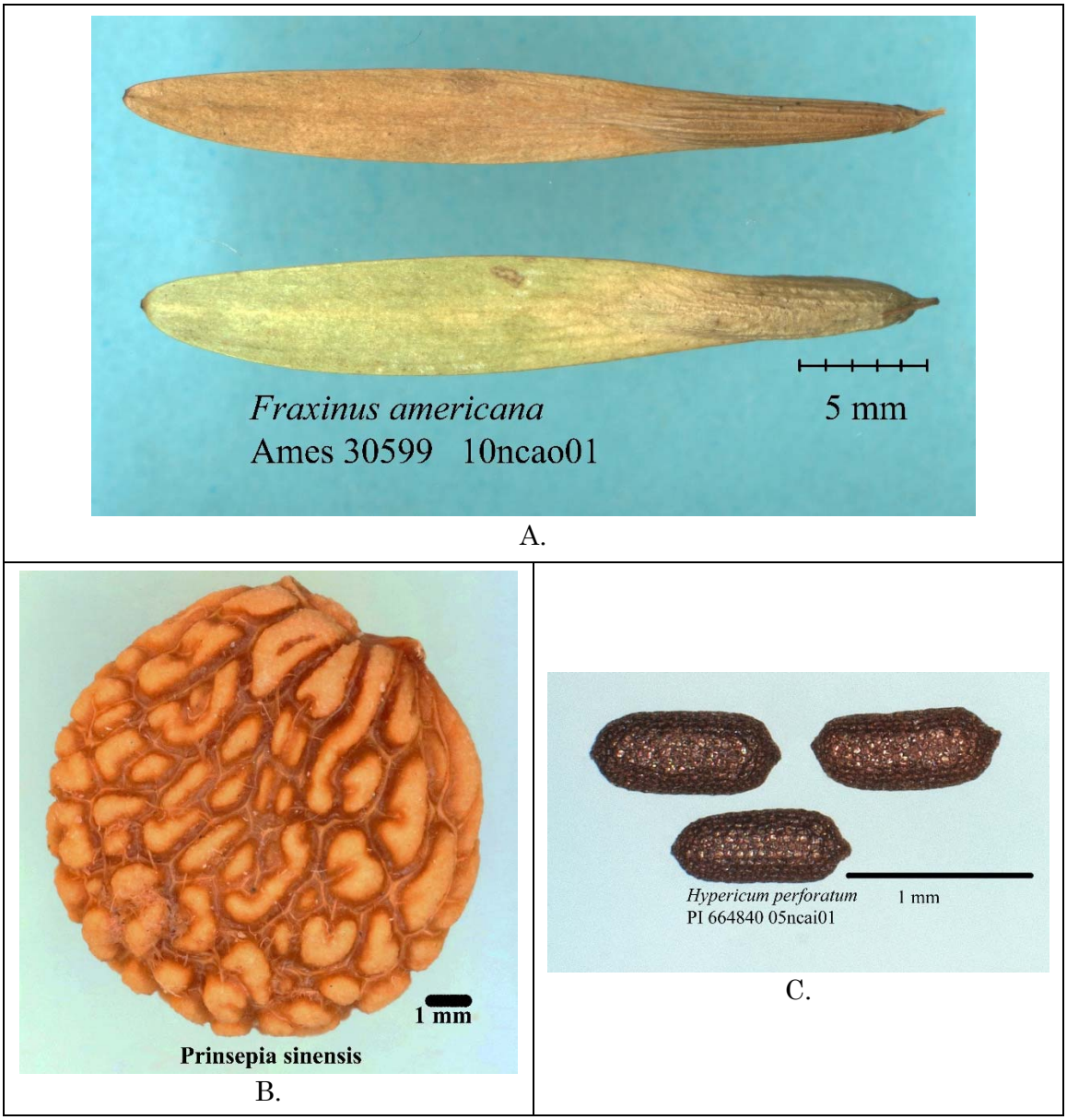


Figure 4. Close-up imaging capabilities at NCRPIS include A) flatbed scanning, B) macrophotography with digital camera and macro lens, and C) microphotography.

Manuscript and Proposal Review:

Dan Barney reviewed four research journal manuscripts on black currant, peony, and plum, and served on a review panel for research proposals submitted to the Romanian EEA research program.

Posters, Presentations, and Seminars:
Dan Barney chaired the Fruit Breeding Working Group business meeting at the American Society for Horticultural Science conference in Orlando, Florida. He also led the planning efforts for a conference workshop entitled "*Sensory Aspects in Plant Breeding*."

Conclusions and Plans for 2015:
The 2014 growing season was generally productive in terms of overall regeneration of the horticulture collections. Progress continued in the acquisition and curation of *Fraxinus* and *Gymnocladus* germplasm.

Curation:
For 2015, we will attempt to obtain seed increases from 77 NC7-medicinals, mints, and ornamentals accessions. Some of the seed lots, however, failed in previous germination attempts and we will probably be able to harvest from about 42 accessions.

For 2015, we will attempt to obtain seed increases from approximately 50 NC7-woody landscape plant accessions.

Following viability testing of 2014 seed lots, the *Baptisia* collection will be transferred to the Ornamental Plant Germplasm Center.

With a planned retirement at the end of September 2015, Dan Barney will focus on developing a five-year management plan for the NC7-medicinals, mints, and ornamentals collections. The plan will emphasize management of high- and medium-priority accessions and will include acquisition recommendations, management strategies, and seed increase schedules through 2020. The goal is to have all high- and medium-priority accessions from these collections backed up and available by the end of 2020. Most of those accessions should also have been assigned PI numbers by the end of 2020.

Evaluation:
Evaluation plans for 2015 will focus on selecting accessions and designing a field layout for provenance test of *Gymnocladus dioicus*.

Research:
Echinacea research will continue on the joint research project with the University of Louisiana Monroe.

Seed dormancy, viability, storage, and germination trials will continue. Taxa of particular interest during 2015 include *Actaea racemosa*, *Hypericum androsaemum*, *H. ascyron* subsp. *pyramidatum*, *H. gentianoides*, *H. hirsutum*, *H. hypericoides*, *H. maculatum*, *H. patulum*, *H. perforatum*, *H. prolificum*, *H. punctatum*, and *H. scabrum*.

Staff Development:
Jeff plans to attend the Woody Landscape Plant Crop Germplasm Committee meeting in July 2015 and the Iowa Shade Tree Short Course in February 2015.

E. Maize Curation (M. Millard)

Personnel:
The Maize curation staff began 2014 experienced and better staffed than in several recent past years. This changed significantly during the 4th quarter of 2014 as Brady North, State Agricultural Specialist II, left in November going to work for Dr. David Dierig at the Bridgestone Americas Biorubber Process Research Center in Mesa, Arizona on guayule. Brady worked at the station for 2 1/2 years helping to increase hundreds of accessions in Ames and was instrumental in clearing up a backlog of increase descriptions and processing. He was also the NCRPIS' main maize man at harvest in 2013 during the federal government shutdown. Congratulations to Brady. He will be missed. The position was advertised the week of December 8, 2014 as an ISU Agricultural Specialist II, closed the week of January 1st, 2015, and our new Ag Specialist, David Zimmerman, started in April 2015. A warm welcome to David! Bruce Hall resigned as federal Agricultural Research Science Technician in December 2014 effective in January 2015. Bruce returns to his home state of Maine to pursue career opportunities there. Bruce was instrumental in implementing LED greenhouse lighting and significantly increased rescue greenhouse increases. He also refined germinating old maize seed in the growth chambers using activated charcoal. Several inbred lines were restarted from very old seed using this method. Bruce also will be missed greatly. Mark Millard continues as maize curator.

Research Progress:
The maize curator continued in 2014 to work on the GRIN-Global project. Public website testers were encouraged to use the GRIN-Global public website in 2014 at http://npgsweb.ars-grin.gov/gringlobal/search.aspx. They were asked to use the help facility, create a login, do searches, and place test orders. No germplasm was sent in response to these test orders, but those on the receiving end of these test orders, including the curator, will be able to respond to the orders as though the order is being processed. By creating a login, the public user will be able to monitor the status of the request, see a history of their requests, mark favorites, etc. Testers were encouraged to use the "Contact Us" button to send feedback directly to the development team. Suggestions for improvements were received and will be incorporated when GRIN-Global goes live, hopefully in 2015. All suggestions are logged and addressed as the website is being continually improved.

The maize curator has been testing many, many GRIN-Global curator tool releases. This tool, after GRIN-Global implementation, should allow curators and germplasm co-workers to more rapidly and efficiently get new data into GRIN-Global. A few months after switching to the GRIN-Global public interface, users should start seeing additional information on the collections on the website. As on current GRIN, availability information on maize collections will be presented in real time on the public GRIN-Global website as availability changes with seed inventory changes.

The NCRPIS staff including, maize curatorial technicians, and student employees were enlisted in 2014 to duplicate their GRIN operations in GRIN-Global. The maize curator as part of the GRIN-Global development team continued to provide advice on solutions to GRIN-Global issues including those presented by testing at all NPGS facilities. Several genebanks across the world including CIMMYT, CIAT, CIP, Chile,

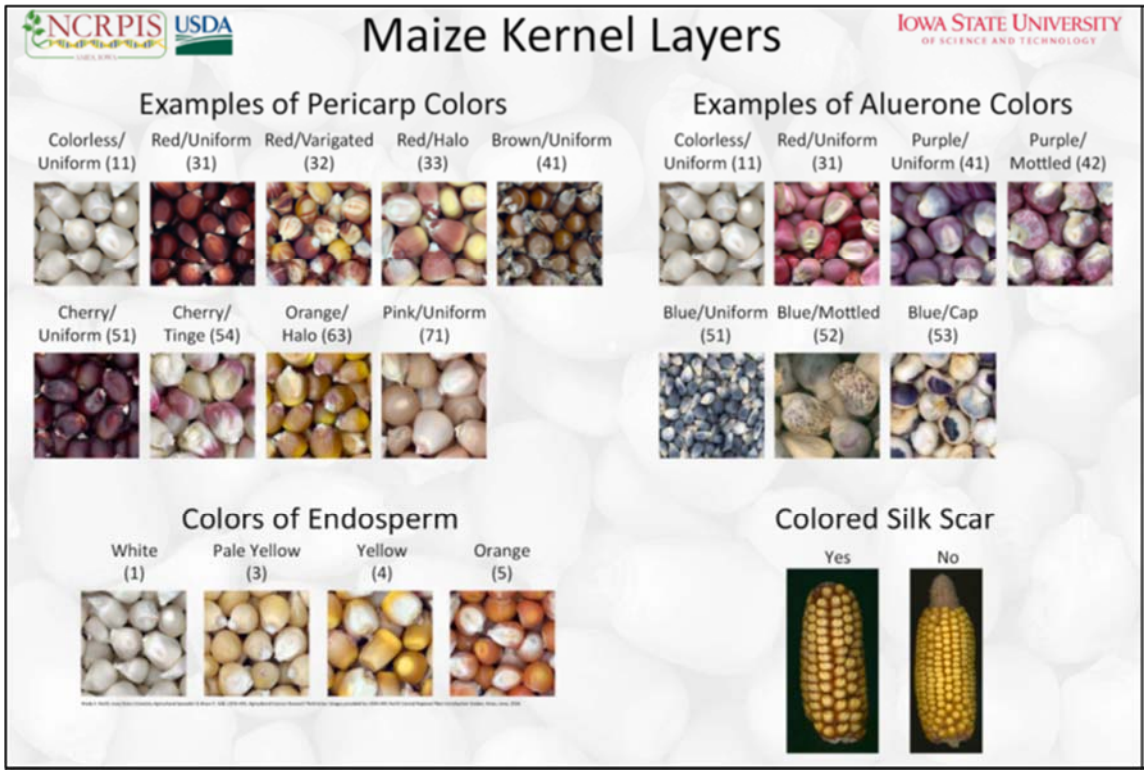
Bolivia, Mexico, and Australia to name a few are in the process of learning, evaluating, and even implementing GRIN-Global in their operations.

Another paper using the SNP data with phenotypic data from the 2500+ maize inbreds held in Ames was published in 2014. Plant height is complicated, but this paper illustrates the diversity for this trait and others that exist within the collection and collection subgroups at the NCRPIS. The reference is: Peiffer, Jason A., Romay, Maria C., Gore, Michael A., Flint-Garcia, Sherry A., Zhang, Zhiwu, Millard, Mark J., Gardner, Candice A.C., McMullen, Michael D., Holland, James B., Bradbury, Peter J., and Buckler, Edward S. 2014. The Genetic Architecture of Maize Height. Genetics. 196(4):1337-1356.

The maize curatorial team is using LED lights to improve greenhouse regeneration success and efficiency. In 2014 the maize technicians researched, procured, and installed additional LED lights in half of the largest NCRPIS farm greenhouse (60' X 215') to cover that portion utilized by the maize curatorial team. The LED lights reduce energy consumption. Improved plant growth and seed yield has already been observed.

Inbred lines have become an important part of the collection and the station has a number of inbreds that were initially maintained in the 1940s, 50s, and 60s by bulking pollen. The maize curator had removed a number of these from available status over the years because it was apparent that these lines had become contaminated during these early sib pollinations. The project continued using the activated carbon technique to go back to original or early generation seed of the 40s and 50s to recover the original inbred. A number of these rescue lines moved to stage two and were grown in the field for uniformity observation and further increase.

The maize curatorial techs assisted the GEM team to develop a series of posters that document the maize curation team's ear and kernel descriptors and trait standards. The images for the posters came from images obtained on all increases during processing by the student employees using flatbed scanners. This project was initiated to help the GEM team capture characterization data of their DH lines. The next page gives a snapshot of one of these posters, which we print on high quality paper in large poster format.



Acquisition:
In 2014, 98 new accessions were received. These included 14 GEM accessions from Raleigh and Ames locations. Texas A&M, through Dr. Seth Murray, donated 9 Texas inbreds, 14 Texas landraces, 5 downy mildew resistant synthetics, and 16 CML lines that they had been maintaining. Nine Journal of Plant Registration (JPR) synthetics from the University of Hawaii were received. We received seed of the sequenced inbred W23 bz2 from Dr. Virginia Walbot and of Oh545 from Dr. Mark Jones. There were 28 expired or soon to be expiring PVPs received.

Regeneration:
Zea accession regeneration attempts in 2014 was 554 accessions (2.5% of the collection). This compares with 216 (1.0% of the collection) in 2013, 410 (2.0% of the collection) in 2012, 475 (2.3% of the collection) in 2011 and 560 (2.8% of the collection) in 2010. For perspective, maize accessions store for about 30 years in the intermediate cold storage conditions at Ames. We should be regenerating at least 690 accessions (3.3%) just to address viability deterioration. The breakdown of the regeneration nurseries are as follows:

1. The Ames summer nursery was increased to 248 accessions in 2014. This compares favorably to 141 in 2013 and 123 in 2012 (2,860 vs. 1,612 rows vs. 1,778 25-foot rows). The nursery was composed of 53 expired or soon to expire PVPs, 108 non-PVP inbreds, 11 GEMs, and 76 populations. Several inbreds in high demand such as the NAM parents were grown at the 20 or 40 rows per accession level rather than the standard 10.

   April was a little too wet in Ames to get an early maize planting, but a break in early May allowed the maize curatorial team to plant the entire nursery May 7th

and 8th, about the average planting date for the maize increases. Development during the rest of May and early June proceeded faster than average with frequent light rain events. There was one 3-inch event in May that did wash out some small areas. Pollinations on the early material (i.e. Mandan maize from North Dakota) started a couple weeks before July 4th which is earlier than average. Several inches of rain during the latter half of June into early July caused a lot of wet spots where denitrification caused yellow stunted rows especially at field edges. Drip irrigation was unnecessary and would have been difficult to set up anyway because the soil was almost always wet. The rest of the summer had frequent light rain events and very moderate temperatures allowing for a good spread of pollination maturities with no severe peaks allowing the staff to keep on top of the pollinations. Since pollinations started early and were well distributed throughout the season, harvest followed the same non-pressured cycle assisted by a long cool fall.

No Stewart's wilt was observed in any increases in 2014 as was the case in 2013, 2012, 2011 and 2010, thus no ELISA testing is necessary on 2014 Ames increase lots to meet phytosanitary requirements. Cold weather in central Iowa during the past five seasons has been a definite benefit in keeping Stewart's wilt under control. Cool weather during almost all the growing season with a long fall is giving good quality seed. Test weights of most accessions is very good. This summer regeneration is rated as above average.

2. Six GEMs were regenerated by the Ames GEM team for the maize collection.

3. DuPont Pioneer Hi-Bred planted, pollinated, harvested, and is quality testing a nursery of 50 tropical populations planted on Puerto Rico in 2014. Many thanks to all at DuPont Pioneer who assist in these large tropical nurseries.

4. Monsanto planted, pollinated, harvested, and is quality testing a nursery of 100 tropical populations planted on Oahu, HI in 2014. The nursery targeted 100 females per population of mainly lowland tropical adaptation. Many thanks to all at Monsanto who assist in these large tropical nurseries.

5. In May 2014, a nursery of 20 tropical accessions was planted, then pollinated and harvested. The nursery was received from St. Croix in September 2014 and was managed by Research Leader Dr. Ricardo Goenaga, USDA-TARS at Mayaguez, PR. Adolfo Quiles retired at the beginning of 2014 and the position has not yet been refilled as of October 2014. Therefore this nursery was small.

6. 3rd Millennium Genetics was contracted in June 2014 to plant, pollinate, and harvest 42 tropical populations that would be adapted to their less busy season. Most accessions were from southern lowland Mexico and Central America. The nursery was received in early October and is awaiting processing. The appearance of the increases looks promising.

7. 3rd Millennium Genetics was contracted in December 2014 to plant, pollinate, and harvest 42 tropical populations. Most accessions were from southern lowland Mexico and Central America, but ten accessions from Zambia in Africa were also included.

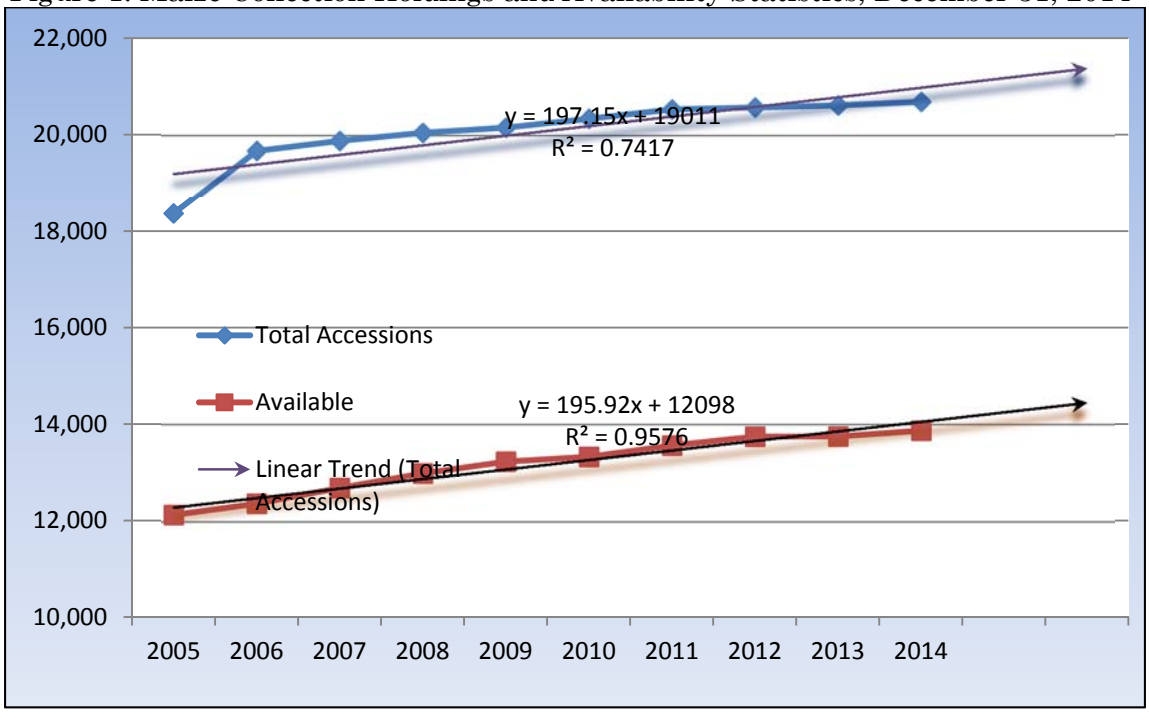
8. Seven GEMs regenerated by the Raleigh GEM team were received and processed in 2014.

9. Ames greenhouse increases planted during 2014 included 48 maize, 5 teosintes, 1 Coix. The maize increases are accessions needing a rescue increase from low quantities and/or low viability

Maintenance:
There were 20,694 accessions of Zea held at the NCRPIS as of December 31, 2014. This represents a .3% increase over the 20,624 accessions held at the NCRPIS at the end of 2013. GEMs and expiring PVPs made up the majority of the additions. The maize curator maintains an additional 100 accessions from the *Coix* and *Tripsacum* genera.

There were 13,876 available accessions at the end of 2014 (67% of the total) compare to 13,757 (66.7% of the total) at the end of 2013, 13,753 (66.8%) at the end of 2012 and 13,572 (66.1%) at the end of 2011. Progress would not be possible without in kind regeneration assistance of Monsanto, Pioneer Hybrid, the GEM programs in North Carolina and Iowa, and others.

Figure 1. Maize Collection Holdings and Availability Statistics, December 31, 2014



This table indicates that *Zea* accession availability continues to maintain though the collection grows and accessions become unavailable. Efforts in recent years have been focused on increasing inbreds and expired PVPs to meet demand. Flat budgets and staffing make substantial increases in the number of available accessions difficult.

Yearly Accession Availability				
Year	**Total Accessions**	**Available Accessions**	**% Available**	**New Accessions**
2005	18,370	12,145	66.1%	75
2006	19,687	12,378	62.9%	285
2007	19,894	12,699	63.8%	124
2008	20,057	12,997	64.8%	150
2009	20,166	12,239	65.7%	105
2010	20,347	13,338	65.6%	178
2011	20,540	13,572	66.1%	180
2012	20,579	13,753	66.8%	39
2013	20,624	13,757	66.7%	39
2014	20,694	13,876	67.7%	98

Viability testing almost tripled in 2014 as more NRPIS resources targeted this area. There were 864 accessions tested in 2014 representing 3.2% of the collection. This compares to 306 accessions tested in 2013 (1.5%), 743 accession (3.6%) in 2012, and 508 (2.5%) in 2011. Five percent, 6%, and 7% of the collection was tested in 2010, 2009, and 2008 respectively. A goal of testing collections every 10 years is desirable to ensure seed is as healthy as possible for research. Seventy-one accessions were backed up at the NCGRP. Zero, 44, 126, 105, and 71 accessions were backed up in 2013, 2012, 2011, 2010, and 2009 respectively. The percent of the collection backed up held at 73%.

Distribution:
Orders for all accessions maintained by the maize curator including those of the genera Tripsacum and Coix decreased 20% in 2014 compared to 2013. This compares to a decrease of 7% in 2013 and increases of 9% in 2012 and 14% in 2011. This decrease can be attributed to two factors. There were only a few expired PVPs in 2013-14. Secondly, there was a policy change in 2013 regarding non-research request. Packet distribution increased 9.8% however.

Annual Distribution Data*								
Year	**Total Packets**	**Foreign Packets**	**Total Accns.**	**Foreign Accns.**	**Orders**	**Foreign Orders**	**Requestors**	**Foreign Requestors**
2010	22,111	1,587	4,296	945	655	73	456	63
2011	16,638	4,087	4,479	2,477	748	78	546	67
2012	20,086	3,412	4,476	1436	814	100	621	88
2013	13,786	3,811	3,573	1,582	755	93	593	83
2014	**15,136**	**4,456**	**3,556**	**1,900**	**603**	**102**	**477**	**93**
Averages 2010-14	17,232	2,931	4,387	1,497	751	84	549	73

*** Includes normal distribution orders, non-research orders, and orders planted for observations. Observations orders are not included in the appendix tables, but are significant in maize.**

In recent years, the NCRPIS policy on **non-research** requests to first time requestors was to send a small number of requested accessions with adequate inventory along with a letter of explanation indicating that we would not distribute any further requests to the first time requestor for **non-research** purposes. **In May 2013**, with all NCRPIS curators in agreement, **the policy was changed** to indicate that no non-research requests would be filled. If the requestor feels his request was incorrectly classified as a non-research request, they are encouraged to communicate in more detail the purpose of their request. This table shows how the change in distribution statistics have changed since classification of this type of order began in 2010. The prediction in 2013 was that this policy change could result in a 10-20% reduction in maize order shipments in 2014 and perhaps a 2-3% reduction in packet distributions. In reality order were reduced 15.4% and packet distribution was reduced 1.6%.

	Distributed				Cancelled			
Year	NR Order Packets	NR Order Accns.	NR Orders	NR Requestors	NR Order Packets	NR Order Accns.	NR Orders	NR Requestors
2010	184	155	54	54	32	32	7	7
2011	318	225	100	97	33	28	13	12
2012	555	237	168	168	121	80	30	29
2013	252	149	110	110	590	289	194	192
2014	0	0	0	0	722	332	297	278

Expired PVP-lines continue to be a major maize distribution category followed by NAM inbred parents, the Goodman-Buckler inbred diversity set, and all other inbred lines.

Orders for expired PVPs were sent to 149 requestors (31% of all *Zea* requestors). Expired PVPs made up some portion of 26% of all Zea orders shipped. Packet distributions of these expired PVP inbreds were reduced from previous years because of a low number of expired PVPs in 2013 and 2014. This reduction is more dramatically expressed in the reduced number of orders because PVPs expire on a monthly basis resulting in multiple orders over the course of a year for several requestors.

Expired PVP Annual Distribution Data				
Year	Total Packets Distributed	Total Accessions Distributed	Orders Processed	Individual Cooperators
2010	5,227	231	234	146
2011	5,137	277	264	158
2012	6,788	303	270	169
2013	6,830	340	269	170
2014	5,125	346	198	149

Characterization:

There were 5,198 data points loaded into GRIN on 332 accessions in 2014. This compares to 7,682 data points on 363 accessions in 2013, 13,212 data points on 5,196 accessions in 2012, and 14,607 data points loaded on 2,807 accessions in 2011. The

number of accessions characterized was down because of fewer accessions being processed and no new traits added as the project awaits GRIN-Global.

We image 365 accessions in 2014 compared to 463, 556, 699, and 520 in 2013, 2012, 2011 and 2009 respectively. This figure is dependent on maize processing which has been flat or reduced in recent years. Image loading to GRIN awaits a new process in GRIN-Global.

Evaluation:
Two disease screening nurseries were distributed in 2014. Dr. Bill Dolezal, DuPont Pioneer Hi-Bred, attempted to screen 250 accessions for northern leaf blight resistance and Diplodia ear rot. The third try on this nursery went well. Many thanks are extended to DuPont Pioneer Hi-Bred for this long-term, continuing contribution. Dr. Charles Block, USDA-ARS pathologist at the NCRPIS, screened 158 accessions for Stewart's wilt resistance and provided field inspections for all Ames nurseries.

Plans for 2015:
In 2015 attending to regenerations and regeneration processing will need to take precedence. Student labor **is** expected to increase, but two technicians will need to be trained, one state and one federal. Two tropical regeneration nurseries are planned. Additional in kind cooperator regeneration are expected. Regeneration remains my first priority because without viable seed, distribution and resulting research cannot be done.

Data will continue to be analyzed and assistance given for publications of the results of the 2,500+ inbred phenotyping/genotyping project.

Monsanto continues to regenerate tropical accessions on Oahu, Hawaii. One hundred tropical accessions will be shipped in February, 2015. Additional nurseries may occur during the winter 2015-2016. Processing was caught up but is expected to lag until new technicians are trained.

Pioneer will be regenerating 50 accessions on Puerto Rico in 2015.

The SNP data provided in 2012 from the inbred genotyping/phenotyping project will be heavily used in determining the status of non-PI'd inbred lines. NSL and Ames numbered accessions will be reviewed and PI numbers assigned. Over 1,200 Ames-numbered accessions and 400 available NSL-numbered accessions could be assigned permanent PI numbers in 2015.

NSL and Ames numbered accessions will be reviewed and PI numbers assigned. Over 1,200 Ames-numbered accessions and 400 available NSL-numbered accessions could be assigned permanent PI numbers in 2014.

GRIN-Global development - assisting NPGS migration from GRIN to GRIN-Global will continue to be a major effort for the maize curator. As more users test, additional needs are identified. Enhancement of versions for deployment in the U.S. is anticipated to continue in 2015.

We will continue acquiring germplasm from public collections.

I will continue to augment the collection of images currently on GRIN of 5,000 accessions with images of additional accessions in FY '15.

A second maize curator and vacant tech positions will be recruited for additional support.

F. Oilseed Crops (L. Marek, L. Crim, I. Larsen, G. Welke)

Project management:
Curator Dr. Laura Marek is assisted by Irvin Larsen, full time USDA Research Technician, by Lloyd Crim, Farm Equipment Operator, who continues to work for the oilseeds project part-time, and by Grace Welke, ISU Agronomy Assistant Scientist III who started with the oilseeds project half time in September. The project is supported by a team of hourly student workers.

Acquisitions:
The oilseed project received 141 new oilseed accessions in 2014.

Brassicaceae:
One new *Brassica carinata* accession was received from a collection trip supported by the USDA-ARS NPGL Plant Exchange Office (PEO) in the Republic of Georgia. A second purported *B. carinata* accession was determined during 2014 regenerations to be an unidentified species in the Caryophyllaceae family. Two *Thlaspi arvense* accessions collected in Colorado were received from Dr. Mark Cruz. Eight *T. arvense* accessions were received from a PEO supported collection exploration in Armenia along with 15 accessions of *Camelina laxa* and undetermined *Camelina* species. We were excited to receive wild collected T. arvense from its area of origin and expect these accessions will help determine if the material being domesticated from naturalized US populations has been through a significant bottleneck. Twenty-six brassicaceae accessions (six assorted *Erysimum* species, 19 assorted *Lepidium* species and one *Noccaea fendleri* accession) were transferred to the NCRPIS from the W6 Regional Plant Introduction Station, material wild collected in the western US in a cooperative project with the BLM SOS.

Helianthus:
Thirteen cultivated *Helianthus annuus* accessions were received in 2014 from the USDA-ARS Sunflower and Plant Biology Research Unit, Fargo, ND with permission to accession and distribute. Forty-three new wild *Helianthus* accessions were received in 2014 including six gap-filling accessions that were wild collected and donated by Chase Mason, graduate student at the University of Georgia, three accessions collected by Dr. Marek in northeast CA, one collection of *H. paradoxus* received from NM, and 33 accessions of 10 different *Helianthus* species transferred to the NCRPIS from the W6 Regional Plant Introduction Station, material wild collected in the western US in a cooperative project with the BLM SOS.

Linum and Miscellaneous Asters:
Eight wild flax and 24 miscellaneous asters were transferred to the NCRPIS from the W6 Regional Plant Introduction Station, material wild collected in the western US in a cooperative project with the BLM, Seeds of Success.

Collection Maintenance:
General statistics about availability and management of the collections are presented in Tables 1 and 2 in the appendix. Selected details for oil seed accessions increased during 2013 are noted below.

Helianthus, Ames regenerations:
Cultivated *H. annuus* accessions are 96% available. We are managing our increases to maintain a high level of availability and to ensure that core collection accessions and other specific accession groups of interest are available. In 2014, 94 cultivated *H. annuus* accessions were regenerated in the field including 95 single row 10 foot plots of 50 accessions in the UGA-SAM1 association mapping population. Twenty-nine accessions were grown in screened cages with added pollinators and 15 were grown in plots of four 20 foot rows with head bagging and sib pollination. Processing of the harvest is under way.

Cultivated *H. annuus* accessions requiring long seasons or short days to flower are increased in the NCRPIS greenhouse as space allows. Three accessions were successfully increased during the winter of 2013-2014.

Wild annual *Helianthus* accessions are 96% available and wild perennial accessions are 81% available. We attempted 14 wild annual *Helianthus* regenerations. Seeds from two accessions did not germinate and the accessions will be inactivated. The 12 successfully established populations were all harvested. We attempted 29 perennial *Helianthus* regenerations and 19 plots were established in the field. Seeds of ten accessions did not germinate and seven of the ten were inactivated. Seed was harvested from two perennial populations previously established in the field.

Helianthus, Parlier alternate grow-out site regenerations:
We continue to partner with National Arid Lands Plant Genetic Resources Unit (NALPGRU), Parlier, CA personnel to regenerate wild taxa requiring longer growing seasons than are reliably obtained in Ames. The Parlier environment also provides a valuable alternative for growing mountain and desert species that do not grow well in mid-western humidity and heavy soils. The Parlier location uses sunflower cages purchased by NCRPIS, and can grow up to 40 wild sunflower accessions per year. We germinate seeds in Ames and ship live seedlings to Parlier in late March or early April. The Parlier staff transplants seedlings and manages plant growth. As in Ames, plots are caged before flowering, pollinator insects are introduced [Ames purchases the honey bee pollinator services], and seed heads are harvested as they mature. Harvested material is shipped to Ames for threshing and processing.

In 2014, we sent seedlings for 33 accessions of wild sunflowers (36 accessions were attempted; three accessions did not germinate and one will be inactivated), and, for the first time, seeds for plots of two cultivated sunflower accessions. One plot was not harvested because the plants were not the correct species due to undetermined error. The 2014 harvested material arrived in Ames in December for processing.

The Parlier staff records basic field data (transplant, flowering and harvest dates) but do not have the personnel resources to record standard descriptor data such as ray and disc flower color, plant height, and branching characteristics nor to take images. Phenotypic information is a valuable component associated with each accession and

it is important to capture the observation data. In September 2014, Mr. Larsen, oilseeds project technician, and I traveled to Parlier to record descriptor information and to take images.

We have an excellent partnership with the NALPGRU staff, ensuring successful regenerations of many wild sunflower taxa. We are most grateful for the dedicated efforts of Mr. Jerry Serimian, Parlier field technician. Curator Dr. Gabriela Romano left the USDA during September 2013 and the search for a new curator continues.

Brassicaceae regenerations:
Brassicaceae accessions are 90% available. In spring 2014, 14 *Brassica napus*, one *B. carinata,* one *B. juncea* and one *Camelina sativa* accession were established in the field. Seed was harvested from ten accessions. Seven of the *B. napus* accessions did not flower and plants were moved into the NCRPIS Farm Greenhouse 2 (FGH-2) with the expectation that the plants would flower in late winter 2015 after receiving a vernalization as mature plants. None of the 2013 fall planted winter type *B. napus* accessions survived the winter which was unusually long and cold. We made one more planting using this method of handling winter type Brassicas (which was moderately successful during the 2012-2013 winter), direct seeding 16 *Brassica napus* and one *B. rapa* accession in September 2014 to be harvested in early summer 2015. In addition, two perennial *Crambe* accessions, maintained in the field from 2012, were harvested in 2013 and 2014. These two accessions will be maintained for one additional season to ensure sufficient seed. One species, *Crambe maritima*, native to southern England and northern France coastal areas, generally does not flower before plants reach four years of age.

Greenhouse 2 (GH2) is managed to provide conditions that approximate a Mediterranean climate, allowing us to regenerate brassicaceae accessions native to that region and other brassicaceae taxa which flower very early in the growing season. We have been focused on making all accessions of *Thlaspi arvense* available. *T. arvense*, native to the Mediterranean area and weedy in agricultural fields worldwide, is of interest because its seed oil has very favorable characteristics for biofuel uses. It flowers very early in the season in Iowa and is present in all NCRPIS farm fields as a weed. To get reasonable regenerations and to ensure the genetic integrity of each accession, we have been increasing *T. arvense* in FGH-2. All 11 of the *Thlaspi arvense* planted in fall 2013 were harvested in late spring 2014. Four *Thlaspi arvense* accessions, one from the 2010 Colorado collections and four from Canada (2012 collections) were started in fall 2014 for winter 2014-2015 greenhouse regeneration. In addition, one accession of *Matthiola incana* was started in fall 2014 for winter greenhouse regeneration.

We are maintaining an additional six brassicaceae accessions in GH-2, including backup plants for the two *Crambe* accessions overwintering in the field. We have harvested seed from four of the greenhouse maintained accessions.

Linum:
Cultivated flax accessions are 99.6% available. Wild flax accessions are 82% available. Three wild flax regenerations were started in 2014.

Cuphea:
No *Cuphea* regenerations were attempted in 2014. Seeds are available for 94% of the accessions of seven species (*Cuphea calophylla, C. carthegenensis, C. lanceolata, C. lutea, C. tolucana, C. viscosissima, C. wrightii)* and the *Cuphea* hybrid accessions that have been part of the agronomic development efforts by members of the National *Cuphea* Consortium. Over all, the *Cuphea* collection is 80% available.

Miscellaneous asters:
The miscellaneous asters are 26% available. We attempted three miscellaneous aster regenerations in 2014; however, seedlings did not survive and these will be attempted again in 2015 using a modified protocol.

Euphorbia:
The *Euphorbia* collection is 41% available. Eight accessions of *Euphorbia lagascae* were regenerated in the field in 2014. *E. lagascae* grows reasonable well during an average Iowa growing season and is the taxon within this genus of greatest interest for seed oil production. Making all *E. lagaseae* accessions available for distribution over the next several years will increase the *Euphorbia* availability to more than 50%.

Inactivations and PI numbering:
During 2014, collection maintenance work necessary to obtain PI numbers for 28 cultivated and 192 wild *Helianthus* Ames numbered accessions was completed by the curator. PI numbers were assigned in March and in December 2014 by Mr. Robert Stebbins. In addition, work necessary to inactivate 44 inviable *Helianthus* accessions and 26 inviable *Alliaria petiolata* accessions was completed by the curator and the accessions transferred to inactive status in December 2014 by Mr. Robert Stebbins.

Distributions:
General statistics about oil seed collection distributions are presented in Tables 3A and 3B in the appendix.

Helianthus:
In 2014, 136 orders containing sunflower accessions containing 3398 items were distributed. The largest single *Helianthus* distribution was an order of 548 cultivated *H. annuus* accessions sent to a University based breeder in Turkey. We sent 1093 packets of the UGA-SAM1 mapping population in three complete and seven partial distributions to six researchers at five different universities working to map genetic loci associated with a range of traits including self-compatibility, heliotrophism, and cold tolerance. Seed packets of 336 accessions were sent to a breeder in India. A new breeder working for a seed company in Germany, who recently received his PhD from ISU, received seeds for more than 400 cultivated sunflower accessions. Seeds were sent for research on metal accumulation, evolutionary analyses (origin of polyploidy), and perenniality, Orders were sent to support genomic research such as marker development and evaluation of inter-specific crosses among the different annual and perennial sunflower species.

Brassicaceae:
In 2014, two large distributions of *Brassica* accessions were sent for disease screening to a researcher at NDSU (432 accessions) and for an association mapping project at Agriculture and Agri-Food Canada (299 accessions). The group at NDSU has been

successful in identifying resistance of interest which they are cross breeding into useful cultivated lines. An order of 247 Brassicaceae accessions were sent to a breeder at Hubei University and 374 Brassicaceae accessions were sent to a sequencing project at the University of Missouri. A third large order (229 accessions) was sent to a group working with cover crops and forage in dry soils in France. Additional orders were sent to various locations for disease screening although the largest number of orders were sent to support breeding research with a variety of goals including adaptation to different environments and identification of useful agronomic and chemical traits at locations around the world. The diversity present in the Brassicaceae collection (262 taxa from 21 genera) supports a wide range of research purposes. One hundred twenty eight unique orders containing 3628 packets of Brassicaceae germplasm were sent out in 2014, 80 containing only *Brassica* accessions, 61 containing Brassicaceae species from other genera and 13 containing packets of both *Brassica* and other genera in the family.

Linum:
Fifteen orders requesting 602 flax accessions were distributed in 2014, the largest of which (200) was sent to a researcher in Taiwan looking for lines appropriate to his subtropical eco-region. Two orders of 135 accessions each were sent to breeders in Turkey looking for disease resistance. Other requesters requested germplasm to examine grain production and comparative genomics within a selection of wild species.

Cuphea:
Seven orders requesting 11 *Cuphea* accessions were distributed in 2014. Researchers were interested in oil characteristics, stem stickiness characteristics, and general growth evaluation.

Euphorbia:
Nine orders requesting 22 Euphorbia accessions were distributed in 2014. Seed was requested for use as reference material, for ornamental development, and to investigate if the species requested were part of natural pathogen host systems.

Miscellaneous asters:
Ten orders containing 76 miscellaneous aster accessions were distributed in 2014. The largest distribution (59 packets) was sent to support phylogeny research in the asteraceae. Other distributions were sent to researchers using native species for riparian buffers and for reference material in archaeological projects.

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

Helianthus:
Disease resistance evaluations: *Sclerotinia* is the most important disease in sunflower production fields in northern North America. We continue to support the NCRPIS pathologist in his work evaluate all wild sunflower taxa for their response to *Sclerotinia*. This work has been a cooperative effort with the pathology group at the USDA-ARS Sunflower and Plant Biology Research Unit in Fargo, ND. However, the pathologist in Fargo retired early in 2014 and the position has not yet been refilled.

Cultivated sunflower self fertility evaluations: We continue to partner with Dr. Jessica Barb, ISU Agronomy Department, who is examining self fertility in cultivated sunflower using the UGA-SAM1 association mapping population which we maintain and distribute. We helped plant the entire 288 line UGA-SAM1 association mapping population in replicated 10 foot single row plots, managed regenerations for a select subset of the population, and assisted in recording observations.

Professional Activities:

Meetings and Presentations:

January: I attended the 2014 National Sunflower Association Research Forum, Fargo, ND. This meeting represents an important opportunity to interact with the domestic sunflower research and production community. I moderated the opening session of the forum and made a presentation about the new sunflower species *H. winteri* during the final session. Following the sunflower meeting in Fargo, I attended the XXII Plant and Animal Genome Conference in San Diego, CA.

August: I participated in the annual NC7 TAC meeting held in West Lafayette, IN and made a presentation about the Ames Oilseed Project.

October: I participated in the NPGS Plant Germplasm Operations Committee (PGOC) meeting in Davis, CA.

November: I attended the annual Agronomy, Crop and Soil Sciences meeting in Long Beach, CA, reported to the New Crops CGC about Oilseed taxa of interest to that group, and attended the Meyer Medal breakfast honoring the scientist I nominated for the award, Gerald Seiler. The National Canola Association met jointly at the Long Beach meeting and I attended the majority of their sponsored sessions. It was an excellent opportunity to interact with North American canola breeding and production programs.

Publications:

Talukder, Z.L., Hulke, B.S., Marek, L.F., and Gulya, T.J. 2014. Sources of resistance to sunflower diseases in a global collection of domesticated USDA plant introductions. Crop Sci. 54:694-705.

Marek, L.F., Barb, J.B., Constable, J.C., and Seiler, G.J. 2014. An exciting new wild sunflower species: *Helianthus winteri*. 36th National Sunflower Association Research Forum, January 8-9. 2014, Fargo, ND. Available: http://www.sunflowernsa.com/uploads/research/1237/marek.et.al_exciting.species_paper_2014.pdf.

Humann, R., Gulya, T., Marek, L., Meyer, S., Jordahl, J., and Markell, S. 2014. Evaluation of wild *Helianthus* germplasm for resistance to a *Plasmopara halstedii* (downey mildew) isolate virulent on P16 and P17. 36th National Sunflower Association Research Forum, January 8-9. 2014, Fargo, ND. Available: http://www.sunflowernsa.com/uploads/research/1236/humann.et.al_eval.helianthus_poster_2014_poster_2014.pdf.

Active Grants:
FY 2014 Southwestern US *Helianthus* collection trip proposal approved and funded $5,000. Role: PI. Trip postponed to 2015 due to extensive regional drought in 2014.

FY2010-2013 Plant Germplasm Evaluation proposal funded, "Evaluation of *Thlaspi* and *Camelina* Accessions", $15,000 (molecular and agronomic analyses). Role: PI. Final spending and account closed in September 2014.

Service Activities:
Journal peer review:
I served as a peer reviewer for submissions to Breeding Science and the Journal of Plant Registrations.

PGOC:
I serve as a member of the GIS and Geo-referencing Subcommittee and the Molecular Subcommittee. The GIS and Geo-referencing Subcommittee has been working with the GRIN Global development team to ensure that all descriptors including new fields recommended by the committee are included in a useful way in the new database.

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

Collections curated by the Vegetable Project include *Cichorium* (NC7-chicory), *Cucumis sativus* (NC7-cucumis.cucs), *Cucumis melo* (NC7-cucumis.melo), *Cucumis* species (NC7-cucumis.wilds), *Cucurbita pepo* (NC7-cucurbita), *Daucus* (NC7-daucus), *Ocimum* (NC7-ocimum), and *Pastinaca* (NC7-parsnips). Statistics for accession numbers and availability for each site crop are found in the appendices in "Table 1: NCRPIS Accessions (Accs), Acquired, Available."

Acquisition:
Seven landrace *Cucumis sativus* and six landrace *Ocimum basilicum* accessions were collected by I. Maisaia, M. Mosulishvili, and T. Tsiklauri from Ilia State University, Tbilisi, Georgia. Two NSSL-numbered *Pastinaca accessions* were received from NCGRP for regeneration and to be incorporated into the NCRPIS collection. The exploration proposal submitted by Drs. David Spooner and Philipp Simon to collect Daucus and Allium in Spain in 2014 was approved in January 2014, but the trip was cancelled in July when SMTA issues could not be resolved.

Maintenance:
Data for vegetable crop regenerations attempted and number of accessions harvested in 2014 are summarized in the appendices in "Table 2: NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up."

Cucumis increases included both greenhouse and field regenerations of 88 *C. melo*, 32 *C. sativus*, and 2 wild *Cucumis* species. Regenerations included newly received landrace cucumbers and accessions with low seed quantities. We are still assessing the 2014 harvests which were significantly impacted by an unusually high infestation of aphids and white flies in many of the cucurbit field cages, as well as an early infestation of powdery mildew. Seed samples are being prepared for viability testing in April 2015.

Cucurbita pepo field regenerations focused on accessions with low seed quantities or distribution lots 20+ years old. Six of ten accessions from the 2014 field cages were successfully regenerated while two failed to set fruit and two produced only a few fruit.

Daucus regeneration efforts focused primarily on Ames-numbered wild, annual species and on old PI-numbered accessions having lower seed quantities. Increased interest continues for the newer collections of wild *Daucus* germplasm for use in carrot pre-breeding programs as sources of disease and pathogen resistance, and heat/drought tolerance. In addition to the Ames, IA *Daucus* 2014 regenerations, we received seed increases on four accessions from Rosa Yzquierdo, Seminis Vegetable Seeds, Idaho; six accessions from Rob Maxwell, Bejo Seeds, Idaho; and six accessions from Paul Heuvelmans, Nunhems (Netherlands). Six cultivated biennial accessions each were sent to Seminis Vegetable Seeds (Idaho) and Bejo Seeds (Oregon), and four wild *Daucus* accessions were sent to Jim Cervantes, Vilmorin, (California) for regeneration in the 2014-2015 growing season.

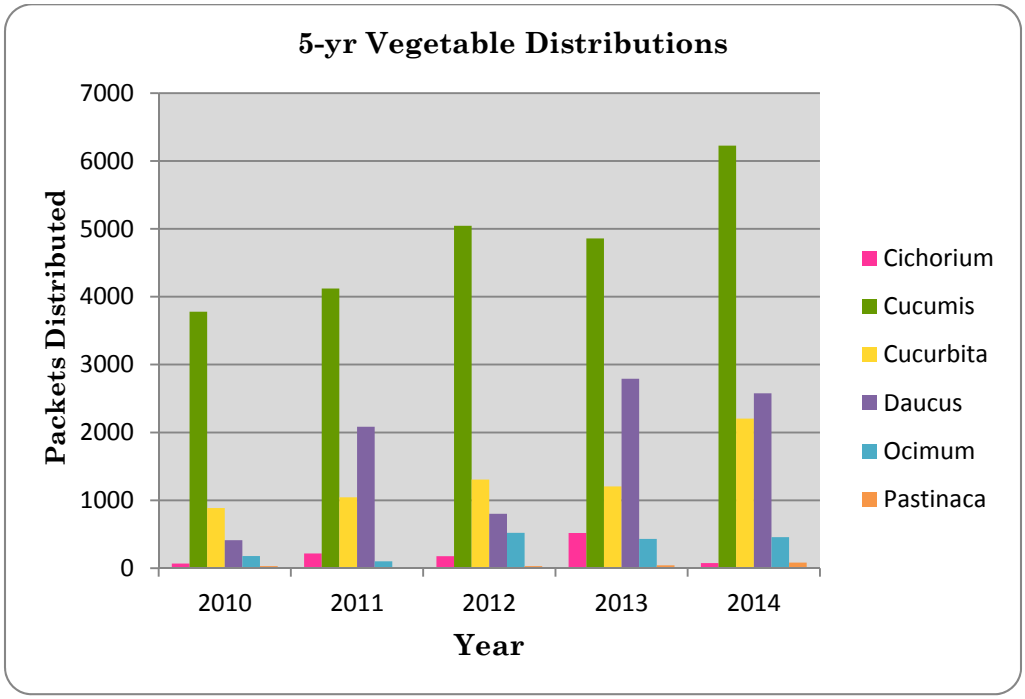
Six new *Ocimum basilicum* L. accessions received from Georgia were regenerated in field cages. Sufficient seed quantities were produced on all accessions to provide backup samples to NCGRP and make available for distribution after viability testing.

New accession of *Ocimum basillicum* L. (basil) from Georgia

As NCRPIS accessions are regenerated, backup seed samples are sent to NCGRP in Ft. Collins. Overall, 84% of the accessions in the vegetable collections are backed up. Six of eight vegetable site-crops have 80% or more of their accessions backed up at NCGRP (Appendix Table 2).

In 2014, 702 vegetable accessions were tested for viability (Appendix Table 2), with the majority of the testing attributed to maintenance germinations on distribution lots.

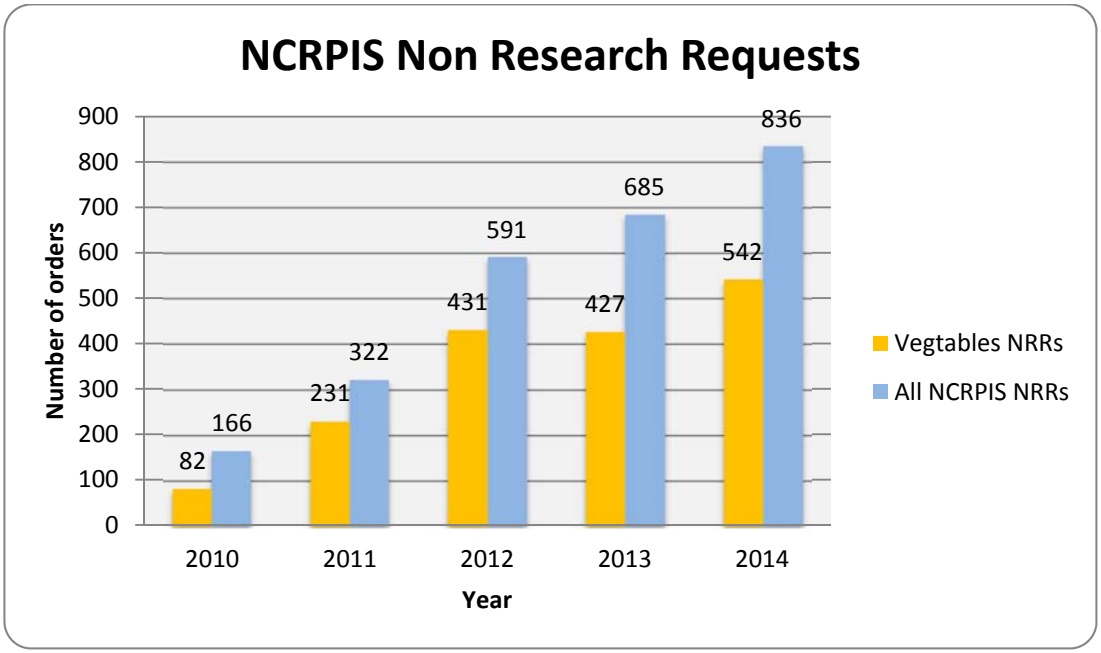
Distribution:
Packet and accession distributions for research and education for the vegetable collections are summarized in the appendices in "Table 3A: External NCRPIS Distributions". In 2014, 11620 seed packets (items) involving 5617 accessions were distributed to fulfill 184 orders (116 domestic, 68 foreign) equaling 148 recipients. This represents 28% of the 41655 total packets distributed by the NCRPIS in 2014. All available *Daucus* (1072 accessions) were sent to Pakistan for diversity evaluation. All or significant portions of the NCRPIS cucurbit collections were requested by seed companies prior to the implementation of the Nagoya Protocol, resulting in 4485 *Cucumis melo* distributions (60% more than 2013) and 2204 *Cucurbita pepo* distributions (45% more than 2013). A five-year distribution history of the vegetable crops is shown in the following chart.



The percent vegetable packet distributions by genus/maintenance crop shows *Pastinaca* and *Cichorium* at less than 1%, *Ocimum* 4%, *Daucus* 22%, *Cucurbita* 19%, and *Cucumis* at 54% (melons 39%, cucumbers 14%, wild species less than 1%). Vegetable research requests received in 2014 included topics such as disease evaluations, breeding for specific traits and disease resistances, evaluation of various cucurbits for use as root stocks, genetic and molecular studies, and diversity assessment for biotic and abiotic stress tolerance.

Non Research Requests (NRR), i.e., home gardener requests, continue to make up a significant portion of the Vegetable Project requests as shown in the "NCRPIS Non Research Requests" chart below. In 2014, 726 orders were received for accessions maintained by the Vegetable Project with 542 of the orders classified as NRR (compared to 498 NRRs received in 2013). Due to the high volume of NRRs received by the NCRPIS as a whole in the first few months of 2013 and the impact such orders were having on station resources, a new policy was implemented in May 2013 to not distribute germplasm resources for home gardening use or for other purposes where

readily available commercial varieties meet the requestor's needs. The new policy replaces the previous one-time-distribution policy for NRRs. We have not seen a decline in NRRs with the 2013 policy change. The number of NRRs received at the NCRPIS continues at a high volume for the vegetable crops even though more of these orders are being cancelled.



Characterization and Taxonomy:
Digital images, and basic notes for taxonomic identification and accession characterization, were recorded during regeneration. Data for approximately 17 descriptors (primarily fruit descriptors) were recorded at harvest for *Cucumis* and *Cucurbita*. Plant habit, flowering dates, and life-cycle notes were recorded for *Daucus*. Images taken of vegetable accessions in 2014 will be loaded to GRIN. Images are taken to document plant, leaf, flower, fruit, or root characteristics.

Format revision of some historical observation data associated with the NC7-CUCUMIS, NC7-CUCURBITA, and NC7-DAUCUS descriptor sets was completed in preparation for the launch of GRIN-Global to facilitate querying for characterization data originally reported as a string of multiple code values rather than distinct letter codes.

Root variability in *Daucus* PI 279777

Taxonomic identities are reviewed and confirmed as each accession is regenerated or grown in observation plots. The 2014 reidentifications included two *Cucumis spp.* re-identified to one *C. metuliferus* and one *C. zambianus*; and one *C. anguria* to *C. melo*. Two *Daucus muricatus* were reidentified to *D. tenuisectus, and* a taxonomic revision resulted in a nomenclature revision of twelve *D. capillifolius* to *D. carota* subsp. *capillifolius*.

Evaluation/Utilization:
Dr. Charles Block (NCRPIS pathologist) continues to screen all *Cucurbita* and *Cucumis* seedlings grown for regeneration for the presence of squash mosaic virus, using ELISA protocols before seedlings are transplanted to the field. Seedling screening has been conducted since 1993. He also visually inspects all cucurbit field plantings for disease during the growing season. Seed-borne diseases are of specific interest, with bacterial fruit blotch (*Acidovorax citrulli*) in *Cucumis melo* being of particular concern. Phytosanitary issues have prevented the distribution of *Cucumis* germplasm to some countries. Please refer to the Plant Pathology Project section of this report for more information.

Publications/Posters:
Arbizu, C., Reitsma, K., Simon, P., and Spooner, D. 2014. Morphometrics of *Daucus* (Apiaceae): A counterpart to a phylogenomic study. American Journal of Botany. 101(11):2005-2016.

Reitsma, K.R., Block, C.C., and Clark, L.C. 2014. Cucurbit Germplasm Collections at the North Central Regional Plant Introduction Station. Proceedings of the Cucurbitaceae 2014 Conference, Bay Harbor, Michigan, October 12-16, 2014. pp 125-128.

Spooner, D., Simon, P., Widrlechner, M., Reitsma, K.R., and Palmquist, D. 2014. Reassessment of Practical Species Identifications of the USDA *Daucus carota* Germplasm Collection: Morphological Data. Crop Science. 54(2):706-718.

Plans for 2015:

Regenerations:

In November 2015, 10 biennial *Daucus* accessions were planted in the greenhouse for regeneration in field cages during the 2015 summer. Many plants of one accession bolted prior to vernalization in February 2015 and are being regenerated as an annual in a greenhouse isolation cage. The remaining biennial accessions will be transplanted into field cages after vernalization for pollination by flies, alfalfa leaf cutter bees and honey bees. Thirteen annual *Daucus* accessions from the arid regions of Morocco and Tunisia that did not thrive under our field conditions were started in germination boxes for transplanting to greenhouse isolation cages for regeneration in the winter greenhouse. Additional 20 to 30 annual *Daucus* accessions will be started in the greenhouse in March 2015 for transplanting to summer field cages. Fifteen *Pastinaca* and 52 *Cichorium* accessions having low viability were also started for regeneration in 2015 summer field cages. Approximately 50 accessions of *Cucumis* and 12 accessions of *Cucurbita* will be regenerated in field cages in the summer. Regenerations of wild *Cucumis* species and hard-to-handle *Cucumis* will continue in the greenhouse as time, space, and other resources permit.

Germinations:

Viability tests will be performed on the 2014 cucurbit regeneration seed lots in April 2015 and on the 2014 *Daucus* regeneration seed lots in the summer of 2015. Maintenance germination testing of *Cucumis*, *Cucurbita*, and *Cichorium* distribution lots are planned for 2015.

Characterization:

Image loading to GRIN "Classic" was suspended in 2013 in preparation for the launch of the new GRIN-Global database. The following images are ready to be loaded:

No. of images	Crop
209	*Cucumis* fruit and plant images 2013
202	*Cucumis* fruit and plant images 2014
36	*Cucurbita* fruit and plant images 2012
15	*Cucurbita* fruit and plant images 2013
27	*Cucurbita* fruit and plant images 2014
13	*Daucus* root images 2012
49	*Daucus* root images 2013
59	*Daucus* root images 2014
30	*Daucus* regeneration images 2013
154	*Daucus* regeneration images 2014

Approximately 200 additional images from the 2013 *Daucus* observation planting as well as images provided by cooperators for cucurbits and *Ocimum* are also being prepared for loading to GRIN-Global.

Review of accession passport data will continue on the cucurbit collections in preparation for assigning PI numbers to many of the Ames-numbered accessions in the collections (414 *Cucumis*, 91 *Cucurbita*, and 99 *Daucus*).

Evaluation:
We are awaiting receipt of evaluation and characterization data resulting from the NPGS funded proposal "Phenotypic and molecular marker evaluation of carrot and wild *Daucus carota* germplasm recently added to the NPGS" submitted by Drs. Philipp Simon and David Spooner (USDA-ARS, Madison, WI) through the Root and Bulb Vegetable Crop Germplasm Committee (RBV-CGC) in 2014. Phenotypic evaluation for key carrot descriptors (storage root shape and color, annual - biennial flowering behavior, other RBV-CGC approved descriptors), and Alternaria leaf blight susceptibility will be collected on the 167 wild and domesticated carrot germplasm accessions collected for the NPGS from 2007 to 2013. Genotyping-by-sequencing (GSB) will be used to characterize the genetic diversity of the germplasm. These data will be integrated with other genomic data to study carrot genetics, domestication, speciation, and evolution. All data collected will be loaded into GRIN.

H. Research Leader Activities (C. Gardner)

Administration and Leadership Activities:
C. Gardner administers the five-year project plan objectives for the USDA-ARS Plant Introduction Research Unit's two CRIS Projects, Plant Introduction Research and the Germplasm Enhancement of Maize (GEM) Project, and contributes to the coordination and execution of activities which support those objectives. Gardner serves as the Coordinator of the Hatch-funded Multistate NC7 Project. Budgetary anomalies due to shifting Congressional and Agency priorities continue to command more time and resources. Because of delays in release of funds to the management unit, each year we may deal with uncertainty. Making timely decisions for work plans for many taxa that require germination and vernalization treatments in the winter can be challenging under these circumstances. The GEM Project CRIS continues to be leveraged to support maize curatorial activities as well, and this cannot continue indefinitely.

About 10% of her time in 2014 was devoted to assisting GRIN-Global System development team members, and more than 60% to serving as the interim GEM maize geneticist/Coordinator. International implementation of the GRIN-Global system is in progress, and focus is now directed to completing USDA security assessments required prior to NPGS implementation.

Pete Cyr, our Software Applications and Network Systems Information Specialist, serves as the development lead for the Curator Tool and Business Tier, and the Project's Technical Director. Other Ames personnel include Mark Millard, our maize curator who serves as systems analyst for the project; Lisa Burke, our seed storage manager who serves as a primary beta tester, and Candice Gardner. NCRPIS

development efforts are primarily devoted to this critically important project. Together with personnel from the ARS GRIN Database Management Unit (DBMU) personnel, National Program Leader (and Project PI) Peter Bretting, other NPGS site personnel with GRIN expertise, and our Global Crop Diversity Trust and international partners, we look forward to NPGS system deployment.

Research Activities:
Adam Vanous pursues a Ph.D. program that deals with phenomena associated with generating haploid and doubled haploid (DH) lines from exotic maize, and with understanding genetic changes that occur during the process of adaptation maize to temperate environments. He also worked with Ag Biosystems engineer to develop software to capture morphometric images from maize ears, which works very well.

As an outcome of Vanous' MS project dealing with methods to double chromosome numbers of haploid lines, thousands of doubled haploid lines were generated from B73 and from Oh43. In 2012 and 2013 we grew these lines for observation, curious about whether DH lines derived from an inbred line would vary. A significant number of lines showed phenotypic variation for morphology, plant and ear height, flowering date, and kernel traits. A new series of questions has been generated about inherent variability in conventionally derived inbred lines, whether the haploid or induction processes are responsible for genetic or epigenetic changes, etc. These lines were topcrossed and will be evaluated in yield trials in 2015.

2015 Plans:
The primary focus of 2015 is to fill vacant NCRPIS positions with outstanding individuals and facilitate smooth transitions, and to assist graduate students in completion and publication of their work.

The GEM Technical Steering Group provided the resources to random mate (sib mate) backcrosses of tropical accessions to ex-PVP maize inbreds. The backcross populations, and progeny of two generations of sibmating were crossed to a haploid induction line in Ames in 2014; plant tissue was sampled and freeze-dried from each mother plant and basic phenotypic data captured. In 2015, the haploid kernels will be separated and prepared for doubling. We seek to determine whether random mating backcross progeny prior to haploid induction favors maximum recovery of the exotic donor genome as compared to inducing the backcross generation. A grant proposal will be prepared to seed funding to support this investigation, in cooperation with GEM Network Cooperators.

Year 2014 Table 1		NCRPIS Accessions (Accs), Acquired, Available					
01/01/2014 to 12/31/2014							
CURATOR	GENUS_CROP	Number Accs	Number Accs Acquired	Percent Acquired	Number Available	Percent Available	Percent Avail Last Year
Barney	NC7-medicinals	504	17	3%	369	73%	73%
	NC7-mints	209	37	18%	135	65%	73%
	NC7-ornamentals	1008	199	20%	524	52%	63%
	Total:	**1721**	**253**	**15%**	1028	60%	**68%**
Brenner	NC7-amaranth	3338	1	0%	3210	96%	97%
	NC7-celosia	57	1	2%	35	61%	63%
	NC7-echinochloa	305	0	0%	280	92%	88%
	NC7-grasses	132	2	2%	85	64%	65%
	NC7-legumes	247	0	0%	115	47%	47%
	NC7-melilotus	1004	0	0%	837	83%	83%
	NC7-panicum	937	2	0%	906	97%	97%
	NC7-perilla	25	0	0%	24	96%	92%
	NC7-portulaca	10	1	10%	7	70%	67%
	NC7-quinoa	363	2	1%	296	82%	79%
	NC7-setaria	1077	63	6%	1006	93%	93%
	NC7-spinach	412	2	0%	404	98%	98%
	NC7-umbels	1180	8	1%	751	64%	61%
	Total:	**9087**	**82**	**1%**	7956	88%	**87%**
Carstens	NC7-woody.landscape	1839	137	7%	938	51%	49%
	Total:	**1839**	**137**	**7%**	938	51%	**49%**
Marek	NC7-asters	415	28	7%	107	26%	27%
	NC7-brassica	2008	2	0%	1859	93%	93%
	NC7-brassica.pvp	6	0	0%	0	0%	0%
	NC7-crucifers	1244	52	4%	1087	87%	85%
	NC7-crucifers.pvp	1	0	0%	0	0%	0%
	NC7-cuphea	639	0	0%	508	79%	80%
	NC7-euphorbia	209	0	0%	82	39%	42%
	NC7-flax	2834	0	0%	2824	100%	100%
	NC7-flax.wilds	142	8	6%	116	82%	81%
	NC7-sun.cults	1873	13	1%	1796	96%	82%
	NC7-sun.cults.SAM	288	0	0%	288	100%	100%
	NC7-sun.wilds.ann	1462	41	3%	1399	96%	95%
	NC7-sun.wilds.per	864	37	4%	699	81%	78%
	NC7-sun.wilds.sp	2	0	0%	0	0%	0%
	Total:	**11987**	**181**	**2%**	10765	90%	**87%**
Millard	NC7-corn.kin	100	0	0%	11	11%	6%
	NC7-maize.gems	226	14	6%	196	87%	85%
	NC7-maize.inb	2540	28	1%	2004	79%	78%
	NC7-maize.pop	17117	28	0%	11251	66%	65%
	NC7-maize.pvp	372	28	8%	342	92%	98%
	NC7-maize.wilds	439	0	0%	83	19%	19%
	NC7-zea.totals	20694	98	0%	13876	67%	67%
	Total:	**20794**	**98**	**0%**	13887	67%	**66%**
Reitsma	NC7-chicory	279	0	0%	212	76%	76%
	NC7-cucumis.cucs	1386	7	1%	1313	95%	95%
	NC7-cucumis.melo	3203	0	0%	2038	64%	71%
	NC7-cucumis.wilds	320	0	0%	184	58%	55%
	NC7-cucurbita	974	0	0%	731	75%	78%
	NC7-daucus	1380	0	0%	1082	78%	76%
	NC7-ocimum	104	6	6%	92	88%	93%
	NC7-parsnips	73	2	3%	50	68%	70%
	Total:	**7719**	**15**	**0%**	5702	74%	**77%**
NCRPIS Total:		**53147**	**766**	**1%**	40276	76%	**76%**

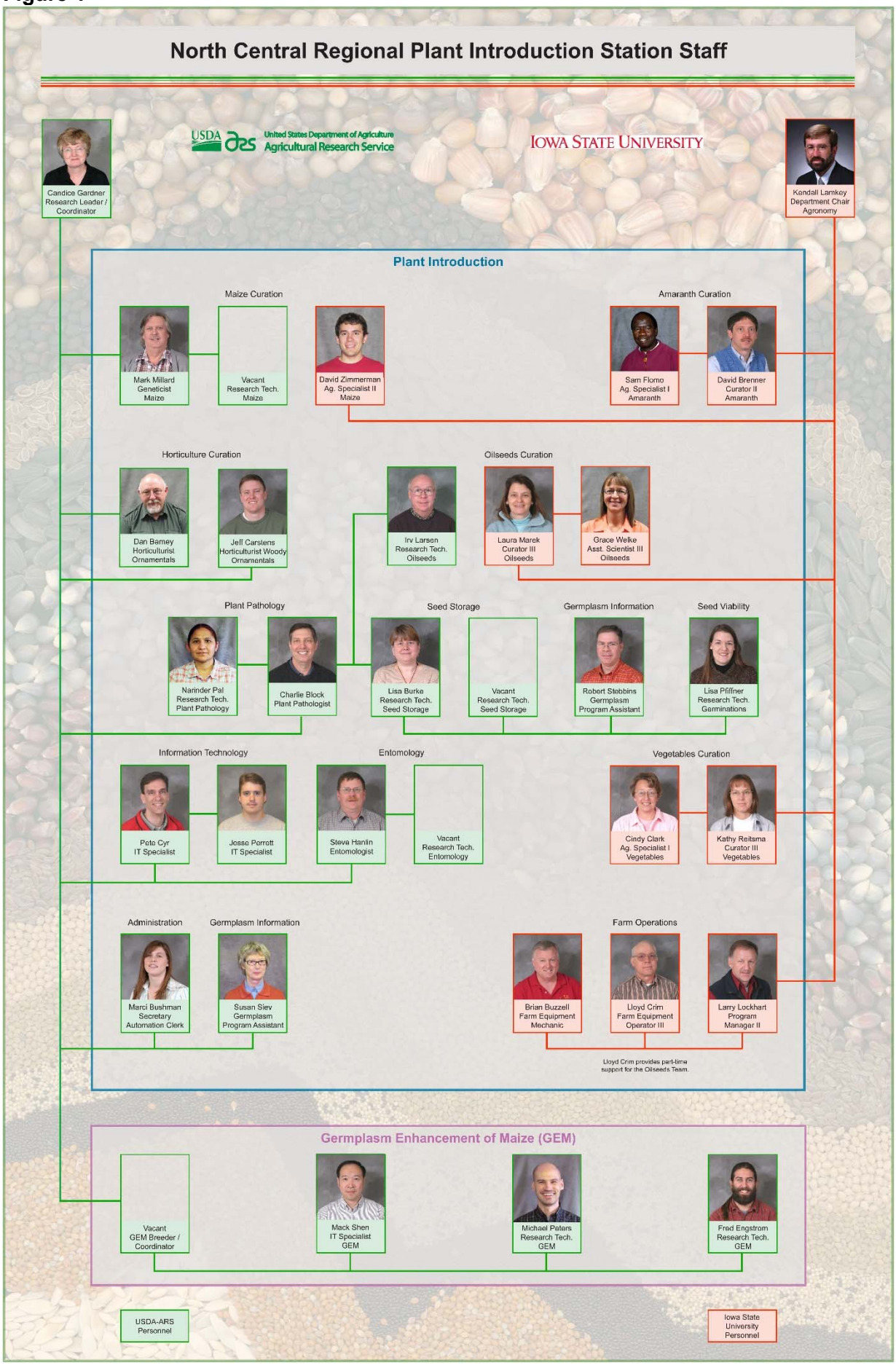
Year 2014 Table 2		NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up											
01/01/2014 to 12/31/2014													
CURATOR	GENUS_CROP	Number Accs	Number Accs Germed	Percent Accs Germed	Number Attempted Regen	Number Harvested Regen	Number Perm Perennial	Number Perennial Harvested (Vegetative)	Number Accs Made Available	Number Accs Growing	Number Accs Backed Up for YR	Total Number Accs Backed Up	Percent Accs Backed Up
Barney	NC7-medicinals	504	15	3%	34	7	0	7	6	0	0	398	79%
	NC7-mints	209	5	2%	15	1	0	0	8	0	0	178	85%
	NC7-ornamentals	1008	51	5%	42	26	0	0	2	0	2	732	73%
	Total:	**1721**	**71**	**4%**	**91**	**34**	**0**	**7**	**16**	**0**	**2**	**1308**	**76%**
Brenner	NC7-amaranth	3338	143	4%	70	71	0	0	2	0	0	3244	97%
	NC7-celosia	57	20	35%	2	1	0	0	0	0	0	36	63%
	NC7-echinochloa	305	14	5%	1	1	0	0	12	0	10	275	90%
	NC7-grasses	132	2	2%	2	4	0	0	1	0	0	90	68%
	NC7-legumes	247	0	0%	1	1	0	0	0	0	0	176	71%
	NC7-melilotus	1004	0	0%	0	30	0	0	0	0	0	899	90%
	NC7-panicum	937	2	0%	3	1	0	0	0	0	0	911	97%
	NC7-perilla	25	4	16%	3	3	0	0	3	0	1	24	96%
	NC7-portulaca	10	5	50%	3	3	0	0	4	0	4	8	80%
	NC7-quinoa	363	24	7%	32	28	0	0	54	0	36	310	85%
	NC7-setaria	1077	25	2%	12	3	0	0	80	0	20	972	90%
	NC7-spinach	412	36	9%	3	35	0	0	28	0	8	399	97%
	NC7-umbels	1180	150	13%	41	18	0	0	57	0	36	754	64%
	Total:	**9087**	**425**	**5%**	**173**	**199**	**0**	**0**	**241**	**0**	**115**	**8098**	**89%**
Carstens	NC7-woody.landscape	1839	51	3%	41	131	29	6	95	0	68	766	42%
	Total:	**1839**	**51**	**3%**	**41**	**131**	**29**	**6**	**95**	**0**	**68**	**766**	**42%**
Marek	NC7-asters	415	7	2%	0	0	0	0	3	0	3	140	34%
	NC7-brassica	2008	94	5%	16	9	8	0	4	1	97	1977	98%
	NC7-brassica.pvp	6	0	0%	0	0	0	0	0	0	0	6	100%
	NC7-crucifers	1244	246	20%	6	39	5	0	59	13	208	1103	89%
	NC7-crucifers.pvp	1	0	0%	0	0	0	0	0	0	0	1	100%
	NC7-cuphea	639	0	0%	0	0	0	14	0	0	0	583	91%
	NC7-euphorbia	209	31	15%	7	7	0	0	0	1	0	85	41%
	NC7-flax	2834	1	0%	0	0	0	0	1	0	0	2832	100%
	NC7-flax.wilds	142	2	1%	7	0	0	0	5	0	0	118	83%
	NC7-sun.cults	1873	58	3%	52	48	0	0	44	12	490	1801	96%
	NC7-sun.cults.SAM	288	285	99%	55	53	0	0	0	4	0	0	0%
	NC7-sun.wilds.ann	1462	133	9%	12	14	0	0	36	3	21	1403	96%
	NC7-sun.wilds.per	864	52	6%	23	24	0	0	46	9	29	685	79%
	NC7-sun.wilds.sp	2	0	0%	0	0	0	0	0	0	0	0	0%
	Total:	**11987**	**909**	**8%**	**178**	**194**	**13**	**14**	**198**	**43**	**848**	**10734**	**90%**
Millard	NC7-corn.kin	100	2	2%	1	3	0	0	4	0	1	11	11%
	NC7-maize.gems	226	35	15%	17	24	0	0	27	0	0	71	31%
	NC7-maize.inb	2540	254	10%	168	145	0	0	88	0	5	1578	62%
	NC7-maize.pop	17117	451	3%	316	125	0	0	91	0	49	13136	77%
	NC7-maize.pvp	372	88	24%	53	53	0	0	47	0	17	370	99%
	NC7-maize.wilds	439	36	8%	0	1	0	0	3	0	0	44	10%
	NC7-zea.totals	20694	864	4%	554	348	0	0	256	0	71	15199	73%
	Total:	**20794**	**866**	**4%**	**555**	**351**	**0**	**0**	**260**	**0**	**72**	**15210**	**73%**
Reitsma	NC7-chicory	279	100	36%	0	0	0	0	0	0	0	244	87%
	NC7-cucumis.cucs	1386	342	25%	30	27	0	0	20	0	8	1311	95%
	NC7-cucumis.melo	3203	74	2%	76	80	0	0	76	0	50	2585	81%
	NC7-cucumis.wilds	320	76	24%	8	1	0	0	9	0	9	186	58%
	NC7-cucurbita	974	4	0%	10	10	0	0	13	0	0	818	84%
	NC7-daucus	1380	54	4%	47	52	0	0	44	0	57	1189	86%
	NC7-ocimum	104	2	2%	6	6	0	0	2	0	2	92	88%
	NC7-parsnips	73	50	68%	15	0	0	0	0	0	0	50	68%
	Total:	**7719**	**702**	**9%**	**192**	**176**	**0**	**0**	**164**	**0**	**126**	**6475**	**84%**
NCRPIS Total:		**53147**	**3024**	**6%**	**1230**	**1085**	**42**	**27**	**974**	**43**	**1231**	**42591**	**80%**

Year 2014 Table 3A			External NCRPIS Distributions											
01/01/2014 to 12/31/2014			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items
Barney	NC7-medicinals	504	59	15	13	81	50	6	5	52	87	21	18	133
	NC7-mints	209	34	17	16	38	6	2	2	6	35	19	18	44
	NC7-ornamentals	1008	75	27	27	78	93	14	13	105	160	41	40	183
	Total:	**1721**	**168**	**48**	**45**	**197**	**149**	**21**	**18**	**163**	**282**	**69**	**63**	**360**
Brenner	NC7-amaranth	3338	623	42	39	797	661	15	15	760	929	57	54	1557
	NC7-celosia	57	8	4	4	8	12	7	6	19	17	11	10	27
	NC7-echinochloa	305	100	9	8	117	23	6	6	24	110	15	14	141
	NC7-grasses	132	10	6	6	12	8	2	2	8	15	8	8	20
	NC7-legumes	247	18	6	6	21	2	1	1	2	18	7	7	23
	NC7-melilotus	1004	17	6	6	17	837	4	3	957	837	10	9	974
	NC7-panicum	937	711	11	11	814	194	11	10	228	722	22	21	1042
	NC7-perilla	25	23	7	7	56	7	2	2	7	23	9	9	63
	NC7-portulaca	10	6	6	6	23	2	1	1	2	6	7	7	25
	NC7-quinoa	363	244	37	33	868	218	36	34	840	271	73	67	1708
	NC7-setaria	1077	129	27	23	199	77	10	10	90	170	37	33	289
	NC7-spinach	412	398	19	15	1303	397	0	0	502	401	19	15	1805
	NC7-umbels	1180	174	22	22	197	77	10	10	78	235	32	32	275
	Total:	**9087**	**2461**	**152**	**130**	**4432**	**2515**	**87**	**78**	**3517**	**3754**	**239**	**208**	**7949**
Carstens	NC7-woody.landscape	1839	107	65	51	193	37	8	7	37	139	73	58	230
	Total:	**1839**	**107**	**65**	**51**	**193**	**37**	**8**	**7**	**37**	**139**	**73**	**58**	**230**
Marek	NC7-asters	415	65	7	6	67	4	2	2	4	68	9	8	71
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-brassica	2008	818	48	40	1249	701	29	26	925	1016	77	66	2174
	NC7-crucifers	1244	532	36	33	656	576	20	20	746	652	56	53	1402
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	639	8	5	4	9	2	1	1	2	10	6	5	11
	NC7-euphorbia	209	11	3	3	13	2	2	2	2	12	5	5	15
	NC7-flax	2834	36	7	7	38	365	5	5	509	393	12	12	547
	NC7-flax.wilds	142	32	2	2	32	23	2	2	23	45	4	4	55
	NC7-sun.cults	1873	161	44	32	216	418	24	22	570	524	68	54	786
	NC7-sun.cults.SAM	288	288	9	5	770	288	1	1	288	288	10	6	1058
	NC7-sun.wilds.ann	1462	188	32	29	205	45	12	12	49	220	44	41	254
	NC7-sun.wilds.per	864	208	34	28	282	60	3	3	60	256	37	31	342
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	**11987**	**2347**	**181**	**139**	**3537**	**2484**	**79**	**71**	**3178**	**3484**	**260**	**210**	**6715**
Millard	NC7-corn.kin	100	10	8	7	24	3	1	1	3	10	9	8	27
	NC7-maize.gems	226	131	26	18	178	203	9	9	953	212	35	27	1131
	NC7-maize.inb	2540	1275	238	195	3953	864	63	61	1384	1514	301	256	5337
	NC7-maize.pop	17117	1766	208	177	2440	473	29	28	501	2112	237	205	2941
	NC7-maize.pvp	372	345	163	118	3513	339	32	28	1470	346	195	146	4983
	NC7-maize.wilds	439	54	43	43	162	78	14	14	200	88	57	57	362
	NC7-zea.totals	20694	3571	497	382	10246	1957	103	94	4508	4272	600	476	14754
	Total:	**20794**	**3581**	**501**	**384**	**10270**	**1960**	**104**	**95**	**4511**	**4282**	**605**	**479**	**14781**
Reitsma	NC7-chicory	279	3	3	3	3	70	3	3	71	70	6	6	74
	NC7-cucumis.cucs	1386	414	22	18	446	880	21	19	1191	1103	43	37	1637
	NC7-cucumis.melo	3202	2270	44	38	3038	882	17	16	1447	2312	61	54	4485
	NC7-cucumis.wilds	321	35	8	7	45	50	7	7	59	72	15	14	104
	NC7-cucurbita	974	603	25	24	662	721	13	11	1542	757	38	35	2204
	NC7-daucus	1380	607	23	17	741	1110	14	12	1835	1161	37	29	2576
	NC7-ocimum	104	91	18	15	370	83	4	3	87	91	22	18	457
	NC7-parsnips	73	31	1	1	31	45	4	4	52	51	5	5	83
	Total:	**7719**	**4054**	**116**	**89**	**5336**	**3841**	**68**	**59**	**6284**	**5617**	**184**	**148**	**11620**
NCRPIS Total:		**53147**	**12718**	**949**	**701**	**23965**	**10986**	**336**	**292**	**17690**	**17558**	**1285**	**993**	**41655**

Year 2014 Table 3B			Cancelled External NCRPIS Items - NR (home gardner) order types											
01/01/2014 to 12/31/2014			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items
Barney	NC7-medicinals	504	61	54	49	118	1	1	1	1	61	55	50	119
	NC7-mints	209	52	85	79	187	0	0	0	0	52	85	79	187
	NC7-ornamentals	1008	124	83	82	240	3	3	3	3	125	86	85	243
	Total:	**1721**	**237**	**164**	**152**	**545**	**4**	**3**	**3**	**4**	**238**	**167**	**155**	**549**
Brenner	NC7-amaranth	3338	87	52	48	109	0	0	0	0	87	52	48	109
	NC7-celosia	57	7	9	9	13	0	0	0	0	7	9	9	13
	NC7-echinochloa	305	4	6	5	6	0	0	0	0	4	6	5	6
	NC7-grasses	132	2	2	2	2	0	0	0	0	2	2	2	2
	NC7-legumes	247	4	5	5	6	0	0	0	0	4	5	5	6
	NC7-melilotus	1004	18	30	30	41	0	0	0	0	18	30	30	41
	NC7-panicum	937	2	2	2	2	0	0	0	0	2	2	2	2
	NC7-perilla	25	4	9	7	13	0	0	0	0	4	9	7	13
	NC7-portulaca	10	4	7	7	10	0	0	0	0	4	7	7	10
	NC7-quinoa	363	49	37	36	74	0	0	0	0	49	37	36	74
	NC7-setaria	1077	8	11	9	13	0	0	0	0	8	11	9	13
	NC7-spinach	412	34	82	78	114	0	0	0	0	34	82	78	114
	NC7-umbels	1180	228	140	130	444	1	1	1	1	228	141	131	445
	Total:	**9087**	**451**	**285**	**263**	**847**	**1**	**1**	**1**	**1**	**451**	**286**	**264**	**848**
Carstens	NC7-woody.landscape	1839	172	82	78	242	0	0	0	0	172	82	78	242
	Total:	**1839**	**172**	**82**	**78**	**242**	**0**	**0**	**0**	**0**	**172**	**82**	**78**	**242**
Marek	NC7-asters	415	23	14	14	33	0	0	0	0	23	14	14	33
	NC7-brassica	2008	40	39	37	66	0	0	0	0	40	39	37	66
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-crucifers	1244	45	42	41	68	0	0	0	0	45	42	41	68
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	639	15	18	16	23	0	0	0	0	15	18	16	23
	NC7-euphorbia	209	2	2	2	3	0	0	0	0	2	2	2	3
	NC7-flax	2834	19	19	19	29	0	0	0	0	19	19	19	29
	NC7-flax.wilds	142	6	5	5	10	0	0	0	0	6	5	5	10
	NC7-sun.cults	1873	112	67	62	177	1	1	1	1	113	68	63	178
	NC7-sun.cults.SAM	288	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1462	33	47	47	71	2	1	1	2	34	48	48	73
	NC7-sun.wilds.per	864	59	53	48	96	1	1	1	1	59	54	49	97
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	**11987**	**354**	**220**	**204**	**576**	**4**	**2**	**2**	**4**	**356**	**222**	**206**	**580**
Millard	NC7-corn.kin	100	2	1	1	2	0	0	0	0	2	1	1	2
	NC7-maize.gems	226	1	1	1	1	0	0	0	0	1	1	1	1
	NC7-maize.inb	2540	34	26	25	38	0	0	0	0	34	26	25	38
	NC7-maize.pop	17117	280	277	262	653	1	1	1	1	280	278	263	654
	NC7-maize.pvp	372	5	18	17	21	0	0	0	0	5	18	17	21
	NC7-maize.wilds	439	10	6	6	11	1	1	1	1	11	7	7	12
	NC7-zea.totals	20694	330	328	311	724	2	2	2	2	331	330	313	726
	Total:	**20794**	**332**	**297**	**278**	**726**	**2**	**2**	**2**	**2**	**333**	**299**	**280**	**728**
Reitsma	NC7-chicory	279	33	19	17	52	0	0	0	0	33	19	17	52
	NC7-cucumis.cucs	1386	178	210	200	471	1	1	1	1	178	211	201	472
	NC7-cucumis.melo	3203	138	167	157	334	1	1	1	1	139	168	158	335
	NC7-cucumis.wilds	320	25	18	18	30	0	0	0	0	25	18	18	30
	NC7-cucurbita	974	103	242	230	552	1	1	1	1	103	243	231	553
	NC7-daucus	1380	126	195	184	426	1	1	1	1	126	196	185	427
	NC7-ocimum	104	69	113	111	305	0	0	0	0	69	113	111	305
	NC7-parsnips	73	21	13	13	28	0	0	0	0	21	13	13	28
	Total:	**7719**	**693**	**539**	**507**	**2198**	**4**	**3**	**3**	**4**	**694**	**542**	**510**	**2202**
NCRPIS Total:		**53147**	**2239**	**829**	**761**	**5134**	**15**	**7**	**7**	**15**	**2244**	**836**	**768**	**5149**

Year 2014 Table 4		NCRPIS Accessions (Accs) Observations (Obs) in GRIN, Images in GRIN								
01/01/2014 to 12/31/2014										
CURATOR	GENUS_CROP	Number Accs in Collection	Number of Accs Obs Trials	Number Obs in GRIN for Year	Number Acc Obs in GRIN for Year	Number Acc Obs In GRIN Last Year	Number Acc Obs in GRIN (all years)	Number of Accs Imaged	Number Acc Images in GRIN for Year	Number Acc Images in GRIN (all years)
Barney	NC7-medicinals	504	18	0	0	9	312	1	4	304
	NC7-mints	209	1	0	0	10	37	0	7	91
	NC7-ornamentals	1008	1	0	0	1	216	0	21	449
	Total:	**1721**	**20**	**0**	**0**	**20**	**565**	**1**	**32**	**844**
Brenner	NC7-amaranth	3338	167	2995	331	12	3336	0	0	873
	NC7-celosia	57	0	0	0	2	56	1	0	19
	NC7-echinochloa	305	1	763	305	14	305	0	0	63
	NC7-grasses	132	0	258	113	0	113	0	1	27
	NC7-legumes	247	0	0	0	3	244	0	0	31
	NC7-melilotus	1004	0	3086	995	46	996	0	0	190
	NC7-panicum	937	4	2471	937	3	937	0	0	127
	NC7-perilla	25	0	0	0	4	25	0	0	11
	NC7-portulaca	10	0	0	0	2	5	0	0	5
	NC7-quinoa	363	12	56	49	42	356	2	0	152
	NC7-setaria	1077	6	3161	1073	14	1073	2	0	157
	NC7-spinach	412	2	2325	401	3	410	0	0	17
	NC7-umbels	1180	0	285	11	31	1148	1	0	212
	Total:	**9087**	**192**	**15400**	**4215**	**176**	**9004**	**6**	**1**	**1884**
Carstens	NC7-woody.landscape	1839	10	0	0	238	818	17	1	807
	Total:	**1839**	**10**	**0**	**0**	**238**	**818**	**17**	**1**	**807**
Marek	NC7-asters	415	0	0	0	0	4	0	2	46
	NC7-brassica	2008	0	22696	1625	0	1962	1	0	333
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0
	NC7-crucifers	1244	1	0	0	0	821	5	1	362
	NC7-crucifers.pvp	1	0	0	0	0	1	0	0	0
	NC7-cuphea	639	0	0	0	0	368	0	0	14
	NC7-euphorbia	209	0	0	0	0	0	0	0	0
	NC7-flax	2834	0	0	0	0	2826	0	0	1
	NC7-flax.wilds	142	0	0	0	0	82	1	1	23
	NC7-sun.cults	1873	44	777	43	344	1829	12	0	256
	NC7-sun.cults.SAM	288	1	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1462	2	186	14	18	1287	39	2	88
	NC7-sun.wilds.per	864	5	405	35	49	603	59	1	145
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0
	Total:	**11987**	**53**	**24064**	**1717**	**411**	**9783**	**117**	**7**	**1268**
Millard	NC7-corn.kin	100	0	0	0	0	0	6	7	7
	NC7-maize.gems	226	0	1036	53	16	185	52	0	103
	NC7-maize.inb	2540	246	1563	131	60	2376	126	0	589
	NC7-maize.pop	17117	0	1610	87	226	14510	117	0	4202
	NC7-maize.pvp	372	120	989	61	55	369	69	0	219
	NC7-maize.wilds	439	0	0	0	0	264	1	0	107
	NC7-zea.totals	20694	366	5198	332	357	17704	365	0	5220
	Total:	**20794**	**366**	**5198**	**332**	**357**	**17704**	**371**	**7**	**5227**
Reitsma	NC7-chicory	279	0	0	0	3	279	0	0	259
	NC7-cucumis.cucs	1386	0	1	1	72	1377	27	0	920
	NC7-cucumis.melo	3203	2	0	0	180	3197	72	0	649
	NC7-cucumis.wilds	320	0	0	0	20	288	1	0	75
	NC7-cucurbita	974	6	252	201	45	970	9	0	151
	NC7-daucus	1380	62	3877	403	402	1363	46	0	687
	NC7-ocimum	104	0	0	0	13	98	6	0	13
	NC7-parsnips	73	0	0	0	1	71	2	0	1
	Total:	**7719**	**70**	**4130**	**605**	**736**	**7643**	**163**	**0**	**2755**
NCRPIS Total:		**53147**	**711**	**48792**	**6869**	**1938**	**45517**	**675**	**48**	**12785**

Figure 1


North Central Regional Plant Introduction Station Staff
USDA ARS United States Department of Agriculture Agricultural Research Service
Iowa State University
Candice Gardner Research Leader / Coordinator
Kendall Lamkey Department Chair Agronomy
Plant Introduction
Maize Curation
Mark Millard Geneticist Maize
Vacant Research Tech. Maize
David Zimmerman Ag. Specialist II Maize
Amaranth Curation
Sam Flomo Ag. Specialist I Amaranth
David Brenner Curator II Amaranth
Horticulture Curation
Dan Barney Horticulturist Ornamentals
Jeff Carstens Horticulturist Woody Ornamentals
Irv Larsen Research Tech. Oilseeds
Oilseeds Curation
Laura Marek Curator III Oilseeds
Grace Welke Asst. Scientist III Oilseeds
Plant Pathology
Narinder Pal Research Tech. Plant Pathology
Charlie Block Plant Pathologist
Seed Storage
Lisa Burke Research Tech. Seed Storage
Vacant Research Tech. Seed Storage
Germplasm Information
Robert Stobbins Germplasm Program Assistant
Seed Viability
Lisa Pfiffner Research Tech. Germinations
Information Technology
Pete Cyr IT Specialist
Jesse Perrott IT Specialist
Entomology
Steve Hanlin Entomologist
Vacant Research Tech. Entomology
Vegetables Curation
Cindy Clark Ag. Specialist I Vegetables
Kathy Reitsma Curator III Vegetables
Administration
Marci Bushman Secretary Automation Clerk
Germplasm Information
Susan Siev Germplasm Program Assistant
Farm Operations
Brian Buzzell Farm Equipment Mechanic
Lloyd Crim Farm Equipment Operator III
Larry Lockhart Program Manager II
Lloyd Crim provides part-time support for the Oilseeds Team.
Germplasm Enhancement of Maize (GEM)
Vacant GEM Breeder / Coordinator
Mack Shen IT Specialist GEM
Michael Peters Research Tech. GEM
Fred Engstrom Research Tech. GEM
USDA-ARS Personnel
Iowa State University Personnel