USDA IOWA STATE UNIVERSITY

NC7 Annual Report

Jan. 1- Dec. 31, 2015

NCRPIS
AMES, IOWA

North Central Regional Plant Introduction Station

NCRPIS ANNUAL REPORT - 2015

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NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2015

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 – July, 2015– May, 2016:

Departures:
- Dan Barney, Horticulturist, retired October 2015
- Lloyd Crim, Farm Equipment Operator, retired May, 2016
- Irvin Larsen, Agri. Research Science Technician, Oilseeds, retired March, 2016
- Susan Siev, Term Germplasm Program Assistant, term expired February, 2016
- Robert Stebbins, Germplasm Program Assistant, resigned May, 2016

Promotions: None to report

New Hires:
- Stacey Estrada, Term Biol Science Technician, February, 2016
- Brady North, Agri. Research Science Technician, Maize Curation, November, 2015
- Nickolis Ouellette, Term Agri Research Science Technician, Horticulture, Oct 2015
- Kallie Webber, Pathways Trainee, Entomology, January, 2016

Transitions:
- Larry Lockhart, NCRPIS Program Manager of 31 years, will retire July 1, 2016
- Charlie Block, Plant Pathologist, will retire July 1, 2016
- Fred Engstrom, GEM Agri Science Research Technician, will start as NCRPIS Program Manager July 1, 2016

Vacant Positions:
- GEM Project Coordinator / Maize Geneticist (June 2016 anticipated start)
- Two Germplasm Program Assistants (one anticipated start in June 2016)
- Agri. Science Research Technician, Oilseeds (vice-Larsen)
- Agri. Specialist, Vegetables & Facilities (NEW, instead of vice-Crim position)
- 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 2015, primarily via the Research Support Agreement with Iowa State University, 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 Stephanie Hadsall 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. In the near future we will be unable to provide incremental salary increases due to Hatch funding constraints.

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 2016 is at full capacity, with about 38 students fulfilling the need for 25 summer FTE. A new GEM Coordinator and one permanent Germplasm Program Assistant have been selected and will start when clearance is completed, hopefully in June 2016. The agronomist (IT) position recruitment process has been initiated. Position descriptions for the second maize geneticist (curator) have not yet been submitted. Hopefully by next year's report these positions will be filled.

Any 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. Given the high turnover of the past two years, a great deal of time and attention has been paid to recruitment and hiring activities, and will continue given the current seven vacancies.

Construction and Facilities:
The project to provide backup generator capacity to the station in three phases was contracted and initiated in 2015 and completed in 2016. This major addition to our infrastructure will contribute to the security of germplasm collections and provide for continuity of operations.

The roofs of the headquarters building and the GEM seed storage cooler building were coated with a polymer during summer 2015 that will extend the lifetime of the roof by several decades.

Four large semi-permanent high tunnel frames were constructed for use as pollinator control for horticulture and oilseeds projects.

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

Greenhouse pest control continues to be augmented with biological controls such as green lacewings (*Chrysoperla rufilabris*), ladybugs (*Hippodamia convergens*), and a whitefly parasite (*Encarsia formosa*).

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:
As funding becomes available, we will continue to upgrade greenhouse 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.

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

(Part IV. summarizes the accomplishments and progress for calendar year 2015 presented in greater detail in the individual staff reports in the document.)

Acquisition and Documentation Highlights:
In 2015, 229 new accessions were acquired (Appendix Table 1). This compares with 766 in 2014; 192 in 2013, 470 in 2012, 485 in 2011, 516 in 2010, and 521 in 2009. New ornamentals include a variety of taxa collected by NCRPIS curators, including ornamentals from the Midwest and south central US (*Gymnocladus dioecious*, *Cornus*, *Spirea*, *Betula*, *Staphlea*, *Fraxinus*), and wild *Helianthus* from PEO funded explorations in AZ, UT, FL, and AL. (See the curators' reports for interesting detail.) An additional 140 unique *Helianthus* were received from D. Burge of the University of British Columbia. *Fraxinus* sp. were contributed by researchers at North Dakota State University, the ARS Woody Landscape Plant Germplasm Repository, the Arnold Arboretum, the Morton Arboretum, and the Benton Arboretum; *Aronia* germplasm was contributed by University of Connecticut collaborator Mark Brand; 60 *Chenopodium* accessions were contributed by Brigham Young University researchers Eric Jellen and Jeff Maughan, and were originally collected using NPGS plant exploration funding.

Maize accessions acquired included GEM released lines from Raleigh, NC and Ames, IA; a *Zea* synthetic developed from intermating the NAM (nested association mapping) parents with teosinte (S. Flint-Garcia, ARS, Univ. of Missouri); a donation of the registration lot of BS39, a race Tusón synthetic adapted to temperate conditions (Arnel Hallauer, ISU); a sequenced variation of inbred W22 (H. Dooner); and 29 expired PVP inbreds.

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 91 accessions in 2015. Taxonomic re-identification was completed for 85 accessions; 13 accessions were nominated for inactivation. R. Stebbins continued to enter old passport information from logbooks for early Ames-numbered accessions.

The *Baptisia* collection was transferred 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 2015, 1,627 accessions were newly grown for regeneration and 1169 were harvested. This contrasts with 1,230 / 1,085 in 2014; 1,184 / 1,048 in 2013; 759 / 954 in 2012; and 1,069 / 1,017 in 2008 (Appendix Table 2). This reflects the intense priority placed on germplasm maintenance as funding becomes available. 2015 growing conditions can be summarized as wet and cold early, moist through July, dry in fall, and generally cooler to normal temperatures. An additional 33 perennials were grown in permanent plantings. About 1180 accessions were made available to the public. Accessions backed up at the NCGRP in Ft. Collins in 2015 numbered 431, compared with 1,231 in 2014, 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%, despite 7% growth in collection size since 2006. Additional accessions (830) were sent to Ft. Collins for assembly with accessions from other NPGS sites for deposit to the Svalbard Global Germplasm Vault.

Curator Brenner successfully increased *Chenopodium quinoa* seeds via a mid-July planting that was harvested in late October; previous spring plantings flowered but failed to set seed. A local wild *Chenopodium* relative is known to flower in late September and October.

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), Vilmorin (J. Cervantes), and New Mexico State University (C. Cramer).

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 21 maize accessions. Raleigh ARS GEM Project Coordinator Matt Krakowsky provided increases of 17 GEM lines and the Ames GEM team regenerated 31 GEM lines. 3rd Millennium Genetics in Puerto Rico was contracted to increase tropical populations as well.

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

Distribution:
Approximately 33% of the germplasm distributions were to international and 67% to domestic requestors. Distributions declined in 2015 from 2014 (Appendix Table 3).

Year	# Items	# Unique Accessions	# Orders	# Requestors
2015	34,188	14,279	1,186	945
2014	41,655	17,558	1,285	993
2013	40,409	17,788	1,523	1,204
2012	45,115	18,811	1,632	1,344
2011	38,402	18,634	1,501	1,180
2010	26,651	13,226		
2009	26,904	13,515	1,487	1,081

The decrease in distributions is directly contributable to efforts to discourage fulfillment of non-research requests (home gardeners), which heavily targeted vegetable germplasm. Approximately one-half of all orders to NC7 were cancelled in 2015 as non-research requests; other NPGS sites are also heavily targeted (Appendix Table 6). 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.

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 2015	% of Total Collections	% of 2015 Distributions	% of 2014 Distributions	% of 2013 Distributions
Barney				1	1
Brenner	9,153	17	18	14	9
Carstens†	3,540	7	3	<1	<1
Marek	12,041	23	26	16	28
Millard	12,041	39	40	35	44
Reitsma	7,724	14	13	28	18
Totals	**53,303**	**100**	**100**	**100**	**100**

†Carstens and Barney collections assumed by Carstens in late 2015

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, quinoa, *Helianthus*, Brassicaceae, flax, *Daucus,* and the culinary umbels for evaluation and characterization were particularly high. Maize inbred requests are driven by the continuing publication of information from genomic (genotyping by sequencing) and phenotypic analyses projects.

Evaluation and Characterization:
In 2015, the NCRPIS utilized 1,134 accessions internally for observation, evaluation and characterization for a wide array of descriptor information, and viability testing was conducted for 7.4% of the collection (Appendix Table 2). Appendix Table 4 lists observations associated with traits entered in the GRIN/GRIN-Global database (http://www.ars.grin.gov/npgs/). Other uses include pathogen testing to meet international distribution requirements and back up. As our pathologist, Dr. Charlie Block, is retiring from ARS in July, it is important to note that he has logged nearly 74,000 pathogen test observations in GRIN during his career; 4,246 of these tests and observations were logged in 2015 (Appendix Table 5). A large backlog of images awaits loading to the GRIN-Global database, following completion of an order loading utility, or wizard.

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 been the sole primary focus of NCRPIS developer Pete Cyr since 2008, and the primary focus of two other NCRPIS staff members, Mark Millard (system analyst) and Lisa Burke (beta testing and training) with substantial time by additional personnel. The Database Management Unit (DBMU) in Beltsville, together with all development team members, the Office of National Program leadership, and the ARS Office of the Chief Information Officer successfully implemented GRIN-Global v1.9.4 in November of 2015. The DBMU is responsible for hosting and maintaining the system, and provides leadership for NPGS implementation. Weekly video training conferences continue to be offered by DBMU personnel (documentation specialist Marty Reisinger) for NPGS site personnel participation, as they have been for the past three years.

GRIN-Global V1.8 was first released to the international community at the start of 2013. US Development Team efforts then re-focused on gap analysis and programming to address implementation needs of the National Plant Germplasm System (NPGS). CIMMYT was the first to implement and go live with a public website. Other CGIAR genebanks are in the process of testing and/or adopting GRIN-Global, and five other national genebanks have either implemented the system or are in the process of doing so. US implementation went 'live' on November 30, 2015. Format revision of some NC7 historical observation data associated with descriptor information sets was completed in preparation for US implementation to facilitate querying of characterization data.

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*. Tests documented that viability of *Betula* sp. seeds stored at 4C is of short duration, with near zero germination, while viability of seeds stored at -18C was much higher.

Pathology team research (C. Block) focused on research to characterize tropical *Pantoea* isolates from corn seed that yield false positives on the Stewart's wilt ELISA test, and believe they have identified the causal organism, and are developing a seed health assay that will distinguish *Pantoea stewartii* from other *Pantoea* species. This is important, as international movement of seed corn typically require freedom from the Stewart's wilt organism. It is anticipated that seed health testing for Goss' wilt will become a common requirement in the near future. Block's lab carried out all seed health testing and fungicide treatment to support international seed shipments.

Field inspections were made for all crops, and all cucurbit seedlings were screened routinely for presence of Squash Mosaic Virus via ELISA; Outcomes are detailed in Dr. Block's section of this report. A Northern corn leaf blight screening trial of maize germplasm with several known Ht genes was conducted, and resistant germplasm identified; the pathogen races continue to change and NCLB has again become a significant concern.

In 2015, the USDA-ARS implemented policies and procedures for testing and managing adventitious presence (AP) of genetically engineered organisms (GEO) in germplasm collections and germplasm releases. In 2015, we tested 1125 maize accessions (1179 seed lots) comprised of 127 GEM lines, 662 populations, 334 expired PVP inbred lines, and two other inbred lines. Of these, one GEM lines, five populations, and two expired PVP lines tested positive for trace AP levels (less than 1%). These seed lots will no longer be distributed, and will be replaced.

Insect management:
The Entomology staff provided six insect pollinator species to control pollinate 868 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 300 lines from 2001-2015, 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 January, 2017. 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 560 visitors toured the NCRPIS during 2015. 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 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. The horticulturists’ report details how collection priorities have been determined, and how gap analyses affect these priorities.

2016 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.

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. Among the benefits for the representatives are the opportunity for exposure to research in areas outside their own area of expertise, leading to greater understanding and insights, and the opportunity for service to their institutions, to the NPGS, and to germplasm security.

Some of the NC-7 RTAC's specific suggestions and contributions from their 2015 Annual Meeting in Ames, IA include the following: (from the meeting minutes):

- The 2015 RTAC meeting was hosted by Thomas Lübberstedt and the staff of the NCRPIS in Ames, 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 tours of the University's Agronomy Farm (a world class operation) and the NCRPIS, presentations by ISU researchers and NC7 representations, and an evening presentation by Norman Cloud of Kemin Industries.
- A warm welcome was extended both by ISU Agricultural Experiment Station Dean Wendy Wintersteen and by Manjit Misra, Director of ISU's Seed Science Center and Chair of the NGRAC (Natl. Genetic Resources Advisory Council). Information was provided on 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.
- The RTAC is concerned that there ARS has no authorized means to recover costs associated with the issue of phytosanitary inspection certificates, seed shipments, and adventitious presence testing for genetically engineered crop accessions. Be it resolved that ARS devote attention to developing a method of recovering costs for these concerns and the authority to do so.
- Five crops have potential for acquisition of accessions that may have transgenes (as their intellectual property protection expires), maize, soybean, sugar beet, canola and cotton. The RTAC believes that providers of these accessions need to provide documentation concerning the transgenes.
- The RTAC is concerned about insufficient back-up generator protection at the NCRPIS, and encourages completion of this project as soon as possible.
- Consideration should be given to increase internal (within each state) outreach for the Plant Introduction Station.
- The committee thanks Dr. Wintersteen, Dr. Lübberstedt and the NCRPIS staff for hosting the 2015 meeting; we look forward to the 2016 meeting.

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 2015, 89 applications for hourly employment were received and reviewed. There were 61 interviews, resulting in 55 new or returning hourly employees hired. Currently there are 19.8 (FTE) Biological Science Aides working at the NCRPIS.

NCRPIS Farm Crew Personnel:
- Larry Lockhart (Program manager II) has been on staff since 1985. Larry is planning to retire July 1, 2016.
- Lloyd Crim (Equipment Operator III) joined the staff in March 1998. He worked half-time for the farm support group and half-time for the oilseeds project. Lloyd retired May 3, 2016.
- 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 installation of three back-up generators.
2. Replaced six windows in the Headquarters Building
3. Coordinated HQ and GEM Cooler Roof Coating Project.
4. Built a new sprayer for post applications on Corn Plots.
5. Administered use biological controls for greenhouse pest control.
6. Finished upgrading the remaining fluorescent fixtures to T-8 lamps.
7. Constructed 4 semi-permanent high tunnel frames for use as pollination control cages by horticulture and oilseeds.
8. Replaced/upgraded heaters in break room, drier cart room and entomology shop.
9. Reorganized shop area, upgraded tool storage.

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

<u>Equipment Purchased</u>:
- Three 30 x 40 high tunnel frames and screens to be used as large field cages for Horticulture and Oilseed Projects
- Three benchtop germinators for germination lab
- Two double door reach-in germinators to replace 15 year old units
- Commercial Sewing Machine used to repair pollination screens
- 25 HP Utility tractor to replace 30 year old tractor
- Plot Stake Printer

High Tunnel frames:

Tours:
During 2015 there were approximately 560 visitors.

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. <u>Information Technology and Telecommunications (P. Cyr and J. Perrett)</u>

Jesse Perrett served as the first-line of support for NCRPIS during 2015. Jesse was supervised by Pete Cyr who is dedicated 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 2015 at NCRPIS.

Equipment:
As of December 2015, NCRPIS has 63 desktop and 33 laptop/tablet workstations installed for use by permanent staff members and part-time temporary student help. Most station computers are equipped with solid state drives, have at least 8 gigabytes of memory, and quad core processors. The centralized functions required by the station were supported by 20 physical servers and around 19 active virtual servers including those used for file storage, intranet, backups, and door security systems.

A Cisco ASA 5525X firewall is installed and configured in order to provide enhanced security as well as increased network performance in line with the gigabit network infrastructure. Each server rack is protected by a battery backup. In addition, a new station generator system was installed to prevent long term power failure. The generators in conjunction with the individual rack mounted battery backups should limit the possibility of power failure related server issues.

The station continues to implement virtual servers wherever possible in order to better utilize existing server capabilities and improve efficiency. Virtual server hosts use 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.

The door security computer hardware was obsolete and was replaced with newer equipment in order to ensure the system remained functional until the new Lenel system can be installed and configured in 2016.

Procured and installed a new WeatherHawk 621 Weather Station to improve weather information reliability. The new station is hard-wired and should not need any regular maintenance. In addition to enhanced reliability and accuracy, the new station measures solar radiation and snowfall in addition to a host of other weather sensors.

Procured and installed a new cell phone repeater system to provide enhanced cellular communications from within the station headquarters building.

Worked with GEM team to install and configure a new tablet computer in the two-plot combine in order to replace an aging Windows XP tablet. Also helped streamline packet and label printing.

Set up a system to help Sunflower crew record 100 seed weights directly from the Ohaus scales to excel after reading barcodes in order to streamline and improve data entry. Also added the capability to immediately print barcoded labels with the 100 seed weight data.

Deployed Smart Card readers and Activeclient software to all computers to ensure availability of multi-factor authentication.

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, Windows 8.1, or Windows 10. All remaining Windows XP computers have been decommissioned. 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. Laptops and tablets were encrypted by bit-locker.

In accordance with ARS security requirements, all computer local admin rights were removed from the workstations. An already installed and configured ISU RSA server was used in conjunction with local RSA SecureID tokens to provide multi-factor authentication for administrative access to computer and server systems per USDA and ARS requirements.

During 2015 a Microsoft System Center Endpoint Protection (SCEP) was decommissioned and Symantec Endpoint Protection (SEP) was installed and configured. In addition to the re-installation of SEP for greater virus and firewall protection, Malwarebytes Anti-Malware and Malwarebytes Anti-Exploit were installed with a centrally managed enterprise version. The combination of these security technologies should provide much better protection against security vulnerabilities and some protection in the event of zero-day exploits. 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.

System Center Configuration Manager (SCCM) is utilized 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.

During 2015 all workstations and servers at NCRPIS received security updates from Microsoft every month via the Iowa State University software update servers.

The DMZ configuration in the firewall was updated to provide better security to DMZ servers while enhancing performance and providing new functionality to Grin Global.

Lincpass cards were issued to all Federal employees and RSA Tokens were issued to the ISU full time employees in order to ensure multi-factor authentication to email was available. Users facilitate connectivity to ARSNet e-mail with Junos Pulse software using LincPass or RSA Tokens for multi-factor authentication. 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. ISU staff await issue of Lincpass credentials.

Documentation:
Continuing to support advanced document management and retention via SharePoint Server 2013 Intranet site. The NCRPIS public webpage was configured using 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 2016:
- Implement monthly windows updates via SCCM.
- Implement Windows 8.1 and Windows 10 where applicable.
- Transition all barcodes and readers to support 2D format.
- 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).

GRIN-Global:
The GRIN-Global project is a joint partnership between the USDA-ARS NPGS, the Global Crop Diversity Trust and Bioversity International. The project goal was to develop a new genebank information management system to replace the legacy 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 Resource Information System (dubbed GRIN-Global) supports five different languages, can be configured to support four database systems, and can be installed on a single desktop computer or a network. On November 30, 2015 the GRIN-Global team deployed GRIN-Global v1.9.4 server software to the USDA/NPGS as a replacement for the legacy GRIN system (which as subsequently been decommissioned). The development of the

curator desktop applications (which includes the Curator Tool, Search Tool, various Wizards, and all reports/labels) had been 'frozen' since January to allow the current 1.9.6.41 version of the client software to be security scanned to ensure no security vulnerabilities were embedded in the client software. The Development Team collaborated with 3rd party contractors to document the GRIN-Global system and to create the Software Development Life Cycle process as part of the commissioning of the GRIN-Global system for the USDA/NPGS.

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

Acquisition:
The North Central Regional Plant Introduction Station (NCRPIS) acquired 381 new accessions in 2015. Of these new accessions, 139 were received from within the National Plant Germplasm System (NPGS) through exploration and transfer. This included 53 accessions of wild *Helianthus* collected by NCRPIS personnel.

The remaining 242 accessions received from outside the NPGS included 140 accessions of wild *Helianthus* from the Southern Oregon University and 60 accessions of *Chenopodium* donated by Brigham Young University.

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, 85 accessions received taxonomic re-identifications. Among these were 62 accessions of *Amaranthus*, 16 accessions of *Daucus*, and seven accessions of *Cucumis*. Also, 13 accessions were nominated for inactivation, including five accessions of *Betula* and three accessions of *Hyoscyamus*. Two accessions of *Amaranthus* were inactivated due to duplication. The inventory lots of these two accessions were integrated together with lots of their respective duplicates.

Additionally, 91 accessions were assigned PI numbers. Included in this group were 30 accessions of *Coriandrum* and 22 accessions of *Amaranthus*.

Conclusions:
Compared to 2014, 387 fewer new accessions were received at the NCRPIS in 2015. Among the maintenance areas, 53 more re-identifications were made, 112 fewer nominations were made to the inactive file, PI-number assignments were 130 lower, and six fewer 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 20-year averages. Resolved duplications were also below the 17-year average.

D. Order processing (R. Stebbins)

During 2015, 2,343 orders were entered into GRIN. These orders led to the external distribution of 33,879 items (primarily seed packets, but also vegetative samples and herbarium specimens). Additionally, 7,640 items were distributed within the NCRPIS, for germination, observation, regeneration, and disease testing. Finally, 738 items were sent to the National Center for Germplasm Resources Preservation (NCGRP), and 830 to The Svalbard Global Seed Vault, for backup.

The number of orders entered into GRIN in 2015 was 231 less than that of 2014; also, the number of items distributed outside the NPGS was down by 8,884. The number of requests received electronically this year was 1,975, a decrease of 221 from 2014.

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

The seed storage area was staffed by two full-time, permanent federal employees (Lisa Burke and Lisa Pfiffner) and two part-time student employees. Lisa Pfiffner's efforts were fully redirected to the germination lab and a fulltime limited appointment (LA) was hired to assist with seed storage duties for 12 months. Lisa Pfiffner then moved into the germination technician position full-time in June of 2015 through a merit promotion. A full-time term employee (Stacey Estrada) was hired in September of 2015 and started work in seed storage on January 11th of 2016.

In 2015, we stored 1998 inventory lots, including 915 original seed lots. Of the original lots stored, 458 were from the Seeds of Success program. Of the increase lots, 787 Ames increases and 296 non-Ames increases were stored. Across all stored lots, 1049 lots had sufficient seed quantities to be made available for distribution. We reviewed 7813 inventory lots for seed quantity, and any discrepancies were corrected in the GRIN database. Six hundred and twenty five samples were prepared and transferred to the -18C freezer for long-term storage.

We filled 1200 seed orders in 2015, including those for distribution, observation, germination, transfer and backup. NCRPIS distributed 37,265 packets to meet distribution and observation requests. There were 606 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. Ninety inventory lots were transferred to other NPGS sites including the *Baptisia* collection which now resides at the Ornamental Plant Germplasm Center in Ohio.

2015 saw the continuation of the prepacking program. With the aid of our student workers, we prepacked 63,590 packets from 6496 inventory lots. Prepacking affects seed storage operations by keeping the on-hand inventories more accurate and speeding up seed order filling. Prepacking also reduces the need to review total seed counts for individual accessions because distribution lots are continually monitored and only reviewed when order activity is high for a given accession. This year we used the order history to determine the number of prepacks to prepare for future use.

NCRPIS continued to participate in sending seed to the Svalbard Global Seed Vault in 2015, by preparing 830 accessions for backup. Sample amounts ranged from 200 to

800 seeds depending on quantity 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 2015, and destinations for both domestic and international shipments were marked. The maps are a stop on tours of the station and are a good visual to show visitors the national and international destinations for our germplasm orders.

Scanning of original seed samples continues. In 2015, 187 scans were made, 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, testing all functionality, proposing enhancements, reporting issues, and providing leadership in training of station personnel.

Lisa Burke continued as the station's CPR/AED/First Aid instructor. She provided three-year First Aid certification for 20 NCRPIS student workers and two-year CPR/AED/First Aid certification for 20 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.

We continued to focus on space utilization by refilling maize jars and freeing up space in the maize extra box areas, thus creating room for future extra bags. A space use analysis of all cold storage space was done and a committee was formed to address the future of storage space for the accessions maintained at NCRPIS.

F. <u>Germination (L. Pfiffner)</u>

The germination lab was staffed by one full-time federal employee (Lisa Pfiffner) and 4 part-time student employees. Lisa Pfiffner divided her time with the seed storage area and the germination lab from the beginning of the year until June of 2015. At that time, she moved into the germination technician position full-time through a merit promotion.

In 2015, the germination lab completed germination or Tetrazolium (TZ) testing on 129 orders containing 4,391 accessions.

Type of Order	# Orders	# Accessions
Regeneration/Other	55	955
Maintenance	66	3408
TZ	8	28

Advances were made in maintenance testing of the following crops, *Daucus* 296 inventory lots tested, *Linum* 401 inventory lots tested and *Zea mays* 900 inventory lots tested. An additional 369 inventory lots were TZ tested after standard germination testing was complete. After the germination test, the remaining ungerminated seeds were tested to verify if they were viable or non-viable, giving a complete look at the state of the inventory lot.

Two new germination chambers and three table top germination chambers were purchased to replace older models.

Attended the Annual AOSA meeting and a TZ workshop, in Tampa, FL.

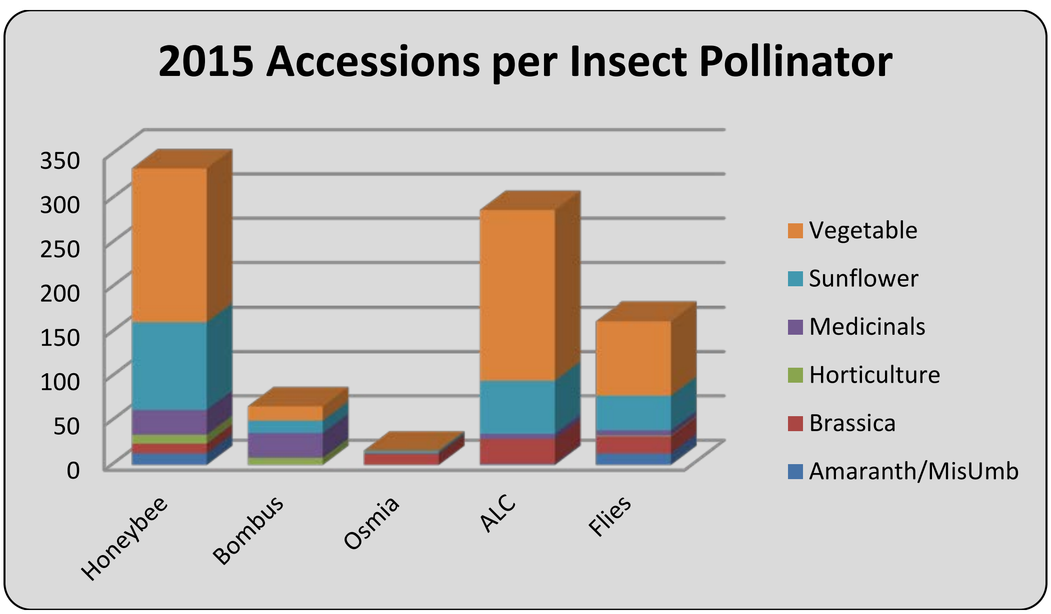
Publication: Brenner, David M., Decker, Jack, Niemi, Jarad, and Pfiffner, Lisa. 2015. Medical Oxygen Concentrators for Releasing Seed Dormancy. Crop Sci. 55:2291-2293.

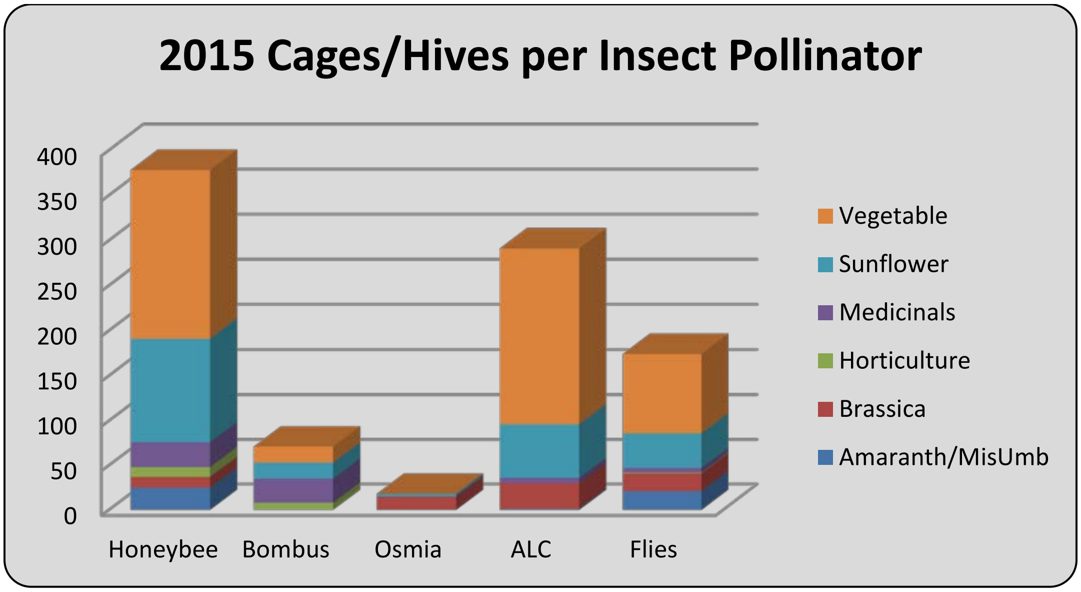
VII. CURATORIAL AND SCIENTIFIC TEAM REPORTS:

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

Summary of Pollinators supplied to 2015 regeneration cages

Number of Unique ACCESSIONS per pollinator						
	Honeybee	*Bombus*	*Osmia*	ALC	Flies	TOTAL
Amaranth/MisUmb	13	0	0	1	13	27
Brassica	12	0	13	28	19	73
Horticulture	10	8	0	0	1	19
Medicinals	28	28	0	6	6	69
Sunflower	99	14	3	60	39	215
Vegetable	173	16	0	192	84	465
OVERALL	335	66	16	289	162	868
Number of TOTAL CAGE/HIVES per pollinator						
	Honeybee	*Bombus*	*Osmia*	ALC	Flies	TOTAL
Amaranth/MisUmb	25	0	0	1	21	47
Brassica	12	0	15	29	20	76
Horticulture	11	8	0	0	1	20
Medicinals	28	27	0	6	5	66
Sunflower	115	18	3	60	39	235
Vegetable	187	18	0	195	88	488
OVERALL	378	71	18	291	174	932





Progress:
Caged pollination:
Bee pollinators (minus the alfalfa leafcutting bee) were supplied a single time to 467 cages for controlled pollination of 417 accessions. Alfalfa leafcutting bee and fly-pollinated cages 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 326 accessions in the field and 9 accessions in a single greenhouse.

2015 Honeybee Pollinator Deliveries to Regeneration Cages

Crop Group	**Total # of Accessions**	**# of Genera**	**# of Accessions/Genera**
Misc.Umbels	13	4	10 *Petroselinum*, 1 *Bifora*, 1 *Carum*, 1 *Eryngium*
Brassica/ Sunflower	12/99	4/1	8 *Brassica*, 2 *Sinapis*, 1 *Crambe* 99 *Helianthus*
Horticulture/ Medicinals	10/28	4/8	7 *Spiraea*, 1 *Euonymus*, 1 *Physocarpus*, 1 *Symphoricarpos*, 8 *Monarda*, 8 *Echinacea*, 4 *Actaea*, 3 *Prunella*, 2 *Calendula*, 1 *Anemone*, 1 *Hypericum*, 1 *Origanum*
Vegetable	173	5	78 *Cucumis*, 37 *Daucus*, 30 *Cichorium*, 20 *Cucurbita*, 8 *Pastinaca*
Total	**335**	**26**	

Overwintering success: 58% of the 43 three story parent colonies, 0% of a single two story parent colonies and 16% of the 31 double-story nucleus colonies stored in the 2015 indoor wintering facility survived, comparable to the 88%, 58% and 7% from 2014.

No colonies were left outside during the winter 2014, all colonies and nucleus hives were placed into the overwintering facility. We removed all colonies and nucs from the room starting on March 10, 2015. In the winter of 2015, we placed in the overwintering room 23 three story parent colonies, 48 two story parent colonies and 48 double story nucleus hives.

We purchased 30 “Buckfast” 3-pound packages and 80 “Buckfast” queens to supplement over-winter losses and to supply spring nucs used for cage pollinations. Because of shipping issues and flooding, the packages and a portion of the queens were picked up by the bee crew in June at the suppliers in Texas. The remaining queens were sent at a later date in the spring. The packages were placed into full size hives and given four feedings of high fructose corn syrup (HFCS) and two pollen treatments. The majority of the queens were placed into nucleus boxes with two frames of brood and a single frame of honey and adhering bees.

In Mid-May we selected queens from resilient, over-wintered parent colonies and set them up in cell builder colonies to produce queens for nucleus hives during summer 2015. Because of receiving cage queens early in June and using them first for nucleus production, we did not start grafting queens until June 15. In the past, we usually begin grafting queens in May. During the grafting time we produced an average of 27 queens per week, with nucleus hives being produced until the second week of August. All nucs which were not used in cages for pollination were fed HFCS, an additional super placed below and treated for mites to prepare them for over-wintering.

In August, all medium-strength single story nucleus hives containing three to four frames of bees and brood, had an additional super placed below and were prepared for over-wintering. Because most of November had higher than normal temperatures and the bees could continue to store syrup, most colonies and nucs going into the over-winter room were heavier than normal. The mortality rate prior to placing into the over-wintering room in December was 5% for the parent colonies and 37% for the nucleus hives.

Mite counts were made using the powdered sugar method in both July and August on 50% of the total colonies. Mite numbers were found to be between 1 to 10 mites per 100 bees which is higher than the documented economic injury levels (EIL). In April all colonies were treated with Amitraz (Apivar®) and in October all hives were treated with formic acid (Mite-Away quick strips). A sugar roll sample was taken after the treatment period and observed mite numbers were lower than before the treatment. (See ARS Photo by Scott Bauer)

In April 2015, all parent colonies and nucleus hives were given five feedings of HFCS with two feedings being medicated with Fumagilin – B® for the prevention of dysentery (Nosema). In October through November, all hives being prepared for over-wintering were given a total of five feedings of HFCS with three medicated feedings of Fumagilin – B®. Beginning on April 14, all parent colonies and double story nucs received two treatments of Terra-Pro (Terramycin). During the summer neither European Foul Brood (EFB) which was found in 2014 nor American Foul Brood (AFB) were observed so no further treatments were given during the summer.

For wax moth control during the summer, stored supers with frames were stacked at right angles to each other to prevent adult moth migration in the equipment room. Starting in June through October, 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" were stored in the overwintering room at a temperature of 60° F. and at right angles. The moths in the dead equipment were not eliminated, but were kept confined to one or two supers and damage limited. In July, the air conditioner (AC) quit operating and there were several weeks before it was repaired. Because of the increase in temperature, some moth damage was observed in several stacks of removed supers. Once the AC was repaired, the moth damage was confined to only the infested supers and the moths did not continue to propagate.

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 crystallization of the HFCS in the large interior storage tank, the contents were circulated daily. Additional HFCS was purchased for the supplement feeding of bees during the summer and into the spring of 2015. New syrup was received on May 20 using two 250 gallon bulk tanks. The bulk tanks were stored in the maintenance shop until they were needed. Once the supply ran out, the tank was taken to the bee shop and the syrup was then pumped out into the main tank. 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.

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 September, flooding occurred at one of the ISU locations. Because of the slow rising water and the light weight of the nucleus hives, most of the nucs and H-frames simply floated out into surrounding fields and as the water receded they were deposited with very little harm done to the nuc. We did lose three of the thirteen nucs at this site because they tipped over and were flooded. In the spring of 2015, we obtained two new outlying apiary sites to replace a site which was sold in 2014 and a location that had flooding issues in the past. Both locations were very successful replacement locations in 2015 and we will continue to use them.

<u>Bombus pollination</u>:
Twenty-eight "mini-research" colonies of *Bombus impatiens* were purchased from a commercial supplier and used to pollinate 71 field cages with 66 accessions. A single *Bombus* hive can be used for pollinating more than one cage with a minimum lapse of 24 hours between sites to prevent pollen contamination. In the *Cucurbita* cages, two hives per cage have been used in the past, however this year all hives were combined with a nuc of honey bees so only one hive was used per cage.

2015 *Bombus* Pollinator Deliveries to Regeneration Cages

Crop Group	Total # of Accessions	# of Genera	# of Accessions/Genera
Horticulture/ Medicinal	8/28	4/4	4 *Staphylea*, 2 *Caragana*, 1 *Physocarpus*, 1 *Symphoricarpos*, 12 *Monarda*, 7 *Echinacea*, 6 *Actaea*, 3 *Prunella*
Sunflower	14	1	14 *Helianthus*
Vegetable	16	2	14 *Cucurbita*, 2 *Cucumis*
Total	**66**	**11**	

We continued to use 60-quart protective plastic containers to house the cardboard *Bombus* hives while in field cages. Two water-filled quart containers are placed inside as weights to prevent the wind from blowing the container and hive off of the stand. The protective shelter, bottles and hive are placed on a honey bee hive body and lid for a stand. The stand prevents the tub and hive from getting flooded in fields which standing water can occur.

<u>*Osmia cornifrons*/*O. lignaria* pollination</u>: *Osmia* were used to pollinate a total of 18 field cages with 21 accessions.

2015 *Osmia* Bee Pollinator Deliveries to Regeneration Cages

Crop Group	# of Cages	Total # of Accessions	# of Genera	# of Accessions/ Genera
Brassica	15	13	3	10 *Brassica*, 2 *Sinapis*, 1 *Camelina*
Sunflower	3	3	1	3 *Linum*
Total	**18**	**16**	**4**	

In the 2014 growing season, we obtained an increase of ca. 181 *Osmia* pupae (9 domiciles at 20 bees/domicile) which could be used for pollination and increase during the 2015 pollination season. We purchased an additional 1000 commercial cells in the spring of 2015 from a new supplier. Normally the cells arrive as pupae in paper tubes, however these pupae were shipped as loose cells. Because of the way the pupae arrived, a new method of introduction was created in which the pupae were divided equally based on sex and number of domiciles needed and poured into the domicile prior to it being hung. All domiciles received the pupae of 25 bees with the sex ratio being 15 male to 10 female.

The pupae were used to fill 29 two-inch domiciles and 26 three-inch domiciles. The two inch domiciles were divided in the following manner, 18 were used in pollination cages and 11 were used at a single "increase" sites. The three inch domiciles were all placed at a single additional "increase" site. The Precision® incubator which was used for storage of all pupae in 2015 had to be defrosted in April, so all pupae had to be relocated for 24 hours to a comparable incubator. The minor break in diapauses did not appear to affect the emergence of adult bees or pollination.

In the fall of 2015, we collected ca. 764 pupae (approximately 38 domiciles) which will be used in the spring of 2016. Additional pupae will be ordered in the spring of 2016 to assure enough pollinators for the spring cages and for placing at "increase" sites.

Through the use of a GPS unit, we plotted and documented the 26 "increase domiciles" at the single location for retrieval later in the summer. Twenty of the three inch domiciles where placed in two apple orchards and six three inch domiciles were placed in a single cherry orchard. The 11 two inch domiciles used for "increase" were placed on the borders of two apple orchards at a separate location.

<u>Alfalfa leafcutting bee (ALC) *Megachile rotundata*</u>:

ALC bees were purchased as larvae in leaf cells from a single supplier for use in 2015, arriving in Ames, IA on November 10, 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 late October 2014 through late October 2015. The 2016 greenhouse pollinations started in early December, bees were collected from the 2015 supply and placed into cages. The 2015 bees were used through late February 2016 and then after were replaced with the newer pupae purchased in 2016.

In 2015, 2690 total ALC deliveries were made to a total of eight fields and three greenhouses with 290 cages containing 287 accessions. One greenhouse cage of *Apiacae* is still undergoing pollination at the transition from 2015 into 2016.

2015 Alfalfa Leafcutter Pollinator Deliveries to Regeneration Cages

Crop Group	**# of Deliveries**	**# of Cages**	**# of Locations**	**# of Accessions**	**# of Genera**	**Time Period**
Misc.Umbels	10	1	1	1	1	April–June
Brassica/ Sunflower	281/238	29/60	3/3	28/60	7/3	Feb. – Oct. July – Oct.
Medicinal	17	5	3	6	5	April – May & Oct.
Vegetables	2144	195	4	192	4	Oct. (14) – Sept.
Total	**2690**	**290**	**14**	**287**	**20**	**Oct. (14) – Oct.**

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 October 2014 through July 2015, greenhouse cages were supplied weekly with bees. 2015 field requests for ALC bees started in late April and the number of weekly active cage increased rapidly through mid-August and then declined with the final field cages being supplied through late October.

In 2015 we received US-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 April, the Precision® incubator needed to be defrosted and all pupal trays were relocated for 24 hours. This is the same incubator which was used for the storage of osmia pupae in 2015 and as with the osmia, there was no observable decline in the emergence of adult bees.

In early October, ALC where still being collected and the caged greenhouse plants had not yet bloomed. Bees were placed into several *Helianthus* and medicinal field cages on a weekly basis.

Flies (Blue Bottle Flies and Houseflies):
Fly pupae of two species (Calliphoridae and *Musca domestica*) were purchased from two suppliers and incubated for weekly use from October 2014, through October 2015 for greenhouse and field pollinations. From June 2015 through August 2015, 26 orders of 10,000 house fly pupae (each) were purchased and from October 2014 through September 2015 250 cups of blue bottle fly pupae were purchased. In 2015, 1340 fly deliveries were made to nine fields and three greenhouses with 174 cages containing 162 accessions representing 20 genera.

An average of 8 greenhouse cages received flies weekly from October 2014 through mid-September 2015. One greenhouse cage of *Apiacae* was still undergoing pollination at the transition from 2015 into 2016. In the field from May through the end of October an average of 38 cages received flies weekly.

2015 Fly Pollinator Deliveries to Regeneration Cages

Crop Group	# of Deliveries	# of Cages	# of Locations	# of Accessions	# of Genera	Time Period
Misc.Umbels	167	21	2	13	4	April – Oct.
Brassica/ Sunflower	82/114	20/39	3/3	19/39	5/1	Feb. – Oct./ Oct.
Horticulture/ Medicinal	4/9	1/5	1/2	1/6	1/5	May/ May & Oct.
Vegetables	964	88	3	84	4	Oct. (2014) – Oct. (2015)
Total	**1340**	**174**	**14**	**162**	**20**	**Oct. (2014) – Oct. (2015)**

Only blue bottle flies were distributed weekly in winter and spring greenhouse cages because blue bottle flies work well at cooler temperatures and due to 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 they are available, bee pollinators may be present in the same cages receiving flies.

Tests:

Winter feeding of over-wintered bees:

In the past, a common overwintering observation has been that the nucleus hives are alive in January/early February, but by March when they are removed from the indoor storage facility, many appear to have starved to death. A possible way to increase the winter survival of the nucleus hives is to supplement the winter feed store with a commercial 'winter feed patty' containing pollen and minerals mixed with syrup. On February 17, 2015, we fed all surviving nucs a one pound winter patty. A limiting factors was the reduced number of nucs that were still alive in February (16%). So all surviving nucleus hives were fed a whole patty which did not allow us to compare if fed nucs survived better than unfed nucs. Also, we had stored the box of patties in the backroom at a temperature of 30° F. This caused difficulty in removal of the wax paper used to separate the individual patties and in some cases the paper was just left on the patty with the assumption that the bees would chew it off. It was observed that the weaker nucs did not chew off the paper to get to the patty and instead only fed where the patty was exposed. An additional concern was whether feeding the winter patties would promote nosema (dysentery of honey bees) inside over-wintered colonies. Although the patty feed had limited use, we did not observe any increase in already change in nosema levels, pre- or post-patty feeding, so we did not feel that the supplemental feeding impacted this health issue in the overwintered hives. In March, once all hives were removed from the winter facility we continued to feed the patties not only to the nucs, but to the colonies. It was observed that once the wax paper was removed from the patties that the bees consumed nearly all of the patty over a one week time period. The plan for the winter of 2016, is to feed the commercial patties to both nucleus hives and two story colonies starting in February. We will again observe hives to see whether nosema levels increase with supplemental patty feeding and/or survival of hives is increased.

Building stronger screen bottom boards:

In the summer of 2013 and 2014, we tested screen bottom boards as a mechanical control for varroa mites and found them to be a good control method with low populations of mites. However, a problem was observed during the summer of 2014 in that the purchased bottom boards were not durable enough for moving and relocating colonies when using the hand cart. The bottom board needed to have a center support placed underneath so that the cart platform would not push up through the screen. The bottom boards also needed to have all joints reinforced. Starting on March 3, 2015 all screened bottom boards had the following modifications done to them. On each side four 6d – 1-7/8" nails were placed, a one inch square board was place at the bottom of each rail to raise them high enough for access with the hand cart, a three inch piece of particle board was placed on the underside in the center and all bottom boards were painted. Because of complications in securing honeybees, their late arrival and set up of the package bees, and a focus on building up established colonies for the production of early nucs and queens, the bottom boards were not placed out in the field and tested in the summer of 2015. In the summer of 2016 the boards will be placed under colonies at six outlying locations starting in April so that they can be tested.

Safety:

Chemical Inventory and Lab Inspections:

On February 20, S. Hanlin updated the Entomology chemical inventory. S. Hanlin also worked with ISU Environmental Health and Safety during the inspections of labs located in the entomology building.

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 November 13, 2014 S. Hanlin completed "Distracted Driving" and "Collision Avoidance" on AgLearn.

Epi-Pens:

In April based on recommendations from ISU Occupational Medicine, S. Hanlin with the assistance of S. Siev sent out a "completion document" and a link to the Epi-pen® website for watching a video on "the signs of anaphylactic shock and the correct use of Epi-pens" to all permanent staff. In May, all completed forms were turned in to Occupational Medicine. No epi-pens were replaced in 2015 because the pens would not expire until January 2016. In the spring of 2016, all epi-pens will be replaced once annual training has been completed in April. The Epi-pens are available at NCRPIS as a precaution, in order to prevent anaphylactic shock in response to bee stings or other allergic reactions.

Presentations and Outreach:

On January 6, S. Hanlin spoke to A. Holgren of Seed Savors about the use of ALC for caged pollination and a list of bee and domiciles suppliers was sent to her via email. Contact with Seed Saver personnel has become a yearly interaction for entomology staff.

On April 21, S. Hanlin was contacted by D. Hargrove of South Texas High Research on the use of honey bees at the station, the crops they are used to pollinate and the design of the nucleus hive. An email was sent to Dr. Hargrove explaining the crops and methods used for cage pollination and an attachment showing the dimensions of the box, lid and bottom board was also sent.

On May 3, S. Hanlin spoke at the "Story County Conservation Spring Festival" on the pollinators used at NCRPIS. This was set up as various booths outdoors with individuals stopping by and asking questions on their own rather than a presentation. In addition to the domiciles and pinned specimens of the pollinating insects, a honey bee observation hive was available for viewing and live specimens of ALC, flies and bumble bees. Honey sticks were passed out to interested individuals. There was also a bean bag toss game and bee suits, gloves and veils available to try on.

On July 17, S. Hanlin was invited to the USDA; ARS Soil Management Research facility in Morris MN to speak at the "Minnesota Honey Producers" summer meeting. This was an outdoor event and was set up as a demonstration presentation. The presentation consisted of a collection of domiciles and rearing equipment used for insect production in addition to the presentation on the various pollinators used at NCRPIS. S. Hanlin spoke on nucleus hive production, queen rearing, emergence of flies and ALC and the distribution methods used for putting the insects in cages. At the end of the day a display table was setup, questions were answered and more detailed discussions of methods provided on.

In 2015, S. Hanlin assist curatorial staff with Pocket Pollinator issues associated with setting up 2015 embedded workbooks for several curators and end of the year curator workbooks used to document total pollinators use per project; these data are entered into GRIN. This will be the last year using the iPAQ hand held and the Pocket Pollinator data base linked to GRIN classic. In 2016, GRIN classic will be replaced by Grin-Global and a new method of requesting and filling pollinators will be used including new devices for capturing the pollination information.

Plans for 2016:

Field testing of improved screen bottom boards:

In the winter of 2015, 31 screen bottom boards were improved by strengthening the joints and placing a center support so that the hand cart could be used in transporting and relocating the colonies. However in the summer of 2015 these bottom boards were never tested in the field. In the summer of 2016, colonies will be placed on these improved bottom boards after they have been relocated to six outlying locations. Along with determining if the improvements allow us to use the hand cart to transfer the colonies without breaking the screen or the sides of the bottom board, we also want to determine if the center board could be an area of re-infestation by mites. We will observe the amount of discarded material which collects on the center board weekly, and monthly take samples from several boards, and place the samples in a white pan to observe whether mites are present.

Winter feeding of OW bees:

In the winter of 2015, we attempted to feed all surviving nucleus hives a purchased winter patty containing a mix of carbohydrates and limited proteins to increase winter survival. However, in early February we only had five surviving nucs and because of storing the box of patties in a cold room we could not get the wax paper dividers off the patties which effected their consumption by the bees. Starting in late January 2016, a second attempt will be made to feed the surviving nucleus hives a quarter of a winter patty, and will store the patties so that the wax paper can easily be removed for feeding. Depending on the length of time that the hives are in the over-wintering room and ease in access, we may also place full patties on two story hives that appear to be short of food. In addition to determining if the patty supplements decrease starvation, we will also observe the level of dysentery (nosema) in the hives by making visual checks of materials on the front of the hives, and determine whether those levels change.

Creating and using new devices and data sheets with GRIN-Global:

Because GRIN classic was replaced by the new international GRIN-Global (GG) system in late 2015, we need to create new forms and obtain handheld PCs or smartphones to replace those used since 2007 with "Pocket Pollinator". Starting in January 2016 we will need to start testing data forms linked to GG for setting up and collecting pollinator requests. We will also need a handheld to enable transfer of information from GG, filling the request in the field, and uploading info back to GG so that hard copy lists in the field and data reentry are not needed. With the help of the IT and curatorial staff, we will create new action codes which can be used to sort, transfer and enter the pollinator requests from GG, create spread sheets for capturing the requests, determine the cage location and fulfill the requests. For the first year, spread sheets and data collection will be tested through the growing season of 2016, then in the fall and winter the system will be evaluated and needed improvements identified to simplify future pollinator requests.

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 could accept a relocation assignment. This condition has been lifted and we filled it in 2016 with a Pathways Trainee. The Pathways program is a vehicle to provide on the job training while a student completes their education; upon completion of a degree the person can be selected for a permanent position.

B. Plant Pathology (C. Block)

Personnel changes:
Narinder Pal started as an agricultural science research technician in May 2015. Narinder brings an extensive set of molecular biology skills which has expanded our diagnostic and research capabilities.

Maize disease research:
We conducted a Northern corn leaf blight (NCLB) field screening trial of 49 GEM releases and 51 other maize accessions, including several with known Ht genes. The initial objective was a side-by-side comparison of resistance to races 0 and 1 of *Exserohilum turcicum*, but a large influx of naturally-occurring race 1 inoculum overwhelmed the plots. Thus resistance to race 0 could not be separately distinguished from race 1. However, dramatic differences in reaction among accessions were noticeable and many entries showed excellent resistance to both races. Seven North Carolina GEM releases were highly resistant with average ratings of 1.0 or less on a 0 to 5 scale. These were GEMS-0004, GEMS-0029, GEMN-0119, GEMN-0120, GEMN-0121, GEMN-0124, and GEMN-0134 as well as two Iowa releases, GEMN-0139 and GEMN-0236. The most resistant inbreds overall were B100 and Mo21R which had essentially no lesion development (rating of zero).

We continued research on characterization of tropical *Pantoea* isolates from corn seed that yield false positives on the Stewart's wilt [*Pantoea (*syn. *Erwinia*) *stewartii*] ELISA. Extensive molecular and biochemical comparisons were made with isolates of *Pantoea stewartii* subsp. *stewartii, P. stewartii* subsp. *indologenes, P. agglomerans, P. ananatis* and various *Erwinia* species. There were small variations among isolates but we believe that we have successfully identified the culprit and are working on a seed health assay that will distinguish the real *Pantoea stewartii* from look-alikes.

Disease Observations on Seed Increase Crops:
The plant pathology team provides support for curators and technicians on plant health questions and disease diagnosis. Plant health monitoring continued with field inspections of seed parent plants for maize (curation and GEM), sunflowers, and cucurbits.

Maize:
We made field inspections of 307 maize seed increase plots. Similarly, 1140 GEM plots were inspected for the same group of diseases. The variety of fungal leaf diseases was more than we have seen in years, probably due to the frequent rains. The dominant disease in terms of incidence of infected plants and leaf area killed was northern corn leaf blight, caused by *Exserohilum turcicum*. A mid- to late-August influx of southern rust (*Puccinia polysora*) was the second widely prevalent disease. In terms of common diseases of phytosanitary concern, none were found – no Stewart's wilt, Goss's wilt, head smut, crazy top or other downy mildew diseases were observed. The last time Stewart's wilt was found at the Station was in 2007.

Sunflower:
Two field inspections were carried out for downy mildew (*Plasmopara halstedii*), 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; annual testing has been done since 1993. One hundred and twelve accessions and 3413 plants were sampled and tested by ELISA. Test results are summarized in Table 1. Nineteen SqMV-infected plants were identified from four accessions. It is somewhat unusual to find SqMV in cucumber (*Cucumis sativus*) or melon (*Cucumis melo*), but all seven infected plants in that group came from the same melon accession. Field plantings were scouted every 2-3 weeks to monitor disease development. The seedling screening combined with cage screening was successful in keeping SqMV out of the seed increase planting.

Table 1: Squash mosaic virus testing results for 2015

Species	**Accessions tested**	**Accessions with infected plants**	**Plants tested**	**# of SqMV infected plants**
Cucumis spp. (melo, sativus)	87	1	2604	7
Cucurbita pepo	25	3	809	12
Total	**112**	**4**	**3413**	**19 (0.55%)**

We conducted multiple disease inspections of the cucurbit cages during July and August. Anthracnose (*Colletotrichum orbiculare*) became a problem on some melon accessions as it was favored by the continual rains. Powdery mildew (*Podosphaera xanthii*) was also difficult to keep in check and regular fungicide sprays were needed for these diseases.

Seed Health Testing/Seed Treatment:
We carry out a seed health testing and fungicide seed treatment program to support international seed shipments – 1748 laboratory tests were run, 1603 for maize (primarily for Stewart's wilt) and 145 for sunflower. Results were added to the GRIN database. Phytosanitary documentation, i.e. freedom from specific pathogens, was provided to support seed shipments for 106 international seed orders.

Managed a seed health testing program to support international seed shipments – 1121 maize accessions were tested for Stewart's or Goss's wilt. Thirty-five sunflower accessions were tested for five fungal pathogens. Trained Narinder in ELISA testing protocols and fungal blotter testing.

Loaded 1741 laboratory seed health testing records to GRIN.

Provided support for curators and techs on plant health questions and disease diagnosis.

Meetings attended:
National Sunflower Association research forum. Fargo, ND (Jan. 11-13, 2016).

ASTA Corn and Soybean research conference, Chicago, IL (Dec 7-11, 2015). Participated in a special session on phytosanitary issues; Plant pathologists' corn diseases meeting.

ASTA Vegetable and Flower seed conference, Tampa, FL (Jan 24-29, 2015).

American Phytopathological Society annual meeting, Pasadena, CA (Aug 1-5, 2015). Seed Pathology committee meeting; Sunflower Pathology Working Group.

Publications:
Markell, S.G., Harveson, R.M., Block, C.C., and Gulya, T.J. 2015. Sunflower Diseases. In Sunflower: Chemistry, Production, Processing and Utilization; Martínez-Force, E., Dunford, N. T., Salas, J. J., Eds.; AOCS Press: Urbana, IL. pp 93-128. Book Chapter.

Talukder, Z., Long, Y., Block, C., Gulya, T., Seiler, G., and Qi, L. 2015. Sclerotinia stalk rot resistance in sunflower: Introgression of resistance from wild annual species and QTL mapping of resistance in cultivated sunflower. Proc. 37th Sunflower Research Forum. Fargo, ND. Jan 6-8, 2015. Website: http://www.sunflowernsa.com/uploads/resources/800/qtl.mapping_talukder_2015.pdf

Shepherd, L.M. and Block, C.C. 201X. Detection of *Pseudomonas savastanoi* pv. *glycinea* in soybean seeds. Book chapter for 2nd edition of "APS Manual on Detection of Plant Pathogenic Bacteria in Seed and Planting Material" (In press).

Block, C.C., Shepherd, L.M., and Pataky, J.K. 201X. Detection of *Pantoea stewartii* ssp. *stewartii* from maize seeds. Book chapter for 2nd edition of "APS Manual on Detection of Plant Pathogenic Bacteria in Seed and Planting Material" (In press).

Shepherd, L.M., Block, C.C., and Vidaver, A.K. 201X. Detection of *Clavibacter michiganensis* subsp. *nebraskensis* in maize seeds. Book chapter for 2nd edition of "APS Manual on Detection of Plant Pathogenic Bacteria in Seed and Planting Material" (In press).

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 61 new accessions, including 60 *Chenopodium* and 1 *Spinacia*. Two *Amaranthus* were inactivated due to duplication and one *Chenopodium* was inactivated due to inviable seeds.

The *Chenopodium* researchers at Brigham Young University, Eric Jellen and Jeff Maughan, donated 60 wild *Chenopodium* accessions (Ames 32979 to 33038) they were collected in the United States with NPGS Plant Exploration Program funding.

Jonathan C. Spero donated seeds of the spinach cultivar 'Monnopa' (Ames 32890). It is said to have a high frequency of monecious plants, which is probably why the cultivar was named Monnopa.

Maintenance:
Availability:
The overall availability for these crops dropped slightly because of the acquisitions. In the spring of 2016 we completed cleaning 63 *Melilotus* seed lots, and the student crew is cleaning the 129 seed lots of harvested or soon to be harvested *Amaranthus*.

Amaranthus:
We had new success in germinating highly dormant wild-species seeds in the hot summer greenhouse. Apparently dormancy was released by high temperatures there. Plantings of Ames 30695 (*Amaranthus hybridus*) and Ames 30696 (*Amaranthus torreyi*) germinated at about 49 ˚C (120 ˚F), and were grown to harvest. These accessions add to the diversity we can offer since they represent types that have been un-available for distribution before. The high temperatures in our summer greenhouse may be an applicable treatment to help with other seed dormancy problem-accessions.

Millets and other grasses:
We had our first quarantine seed increase grow-out under a permit from APHIS which required that a local independent Plant Pathologist verify that the increase was isolated correctly. Four accessions from Ilia State University in the Republic of Georgia, (two *Panicum* Ames 32315 & Ames 32316 and two *Setaria* Ames 32317 & Ames 32318) were planted in greenhouse isolation after the local vegetation froze in 2014 at the end of the growing season, and were harvested in the spring of 2015. After the successful increase the foliage, soil, and original seed lots were autoclaved to prevent release of potential disease organisms. We are permitted to distribute the new seeds lots without restriction.

Melilotus:
Sixty-three newly regenerated seed lots were cleaned and will be viability tested and stored in 2016. The new vibratory deck seed cleaner was helpful for this seed cleaning.

Miscellaneous Apiaceae:
We had a good 2015 regeneration year for parsley in field cages, partly because of improved field drainage. One of the parsley accessions from Morocco (Ames 32069) had about 60% non-bolting plants even though planted the previous August. We attempted to over-winter the non-bolting plants under thick wood-chip mulch, for flowering in 2016. The non-bolting plants have a long period as lush leafy plants; so the non-bolting trait could be useful. We plan to harvest seeds of *Angelica* and *Eryngium* in 2016 after establishing the plants in the field in 2015.

Perilla:
Three *Perilla* accessions were regenerated in 2015. We are gradually replacing all the *Perilla* distribution seed lots since they have relatively a short storage life. Under our 4°C storage conditions their seed viability is generally too low for distribution after 20 years.

Portulaca:
The original seed lot of Ames 32099 *Portulaca pilosa* was the source of a second species segregated from a mixture, *Portulaca amilis*; a species that is new to the collection. The segregated seed lot will be accessioned separately in 2016.

Figure 1. A flower of *Portulaca amilis* segregated from Ames 32099.

Spinacia:
Two wild spinach accessions were regenerated in our Ames facilities, and two more were planted for harvesting in 2016.

Viability testing:
A total of 983 accessions (11% of our collections) were assayed for viability in 2015, an increase from 5% in 2014.

GRIN database management:

New PI numbers were assigned to 72 temporary-numbered accessions in these crops. Seventy-six literature citations were loaded in GRIN. David Brenner and Susan Siev added 251 secondary identifiers to old accessions that previously had only skeleton records. Many of these new identifiers were for germplasm received in the 1990s, from Nepal. The report on a 1984 Bioversity Plant exploration in Nepal was in our files but absent from the Bioversity files, so we provided a copy for the Bioversity online archive.

Characterization/evaluation/taxonomy:

Amaranthus:

Michael W. Palmer of Oklahoma State University informed me about an insect pest on *Amaranthus* that I was unaware of. The amaranth flea beetle (*Disonycha glabrata*) has only been a problem for his vegetable amaranth for a couple of years. It is in the same tribe as the cucumber beetle, and it looks similar. Palmer reports that the amaranth flea beetle destroys local wild amaranths. This beetle is not a problem for the related vegetable *Celosia*. After Palmer told me about the amaranth flea beetle; I remembered seeing cucumber beetles on amaranth leaves in Iowa, which may have been amaranth flea beetles. For now this insect is a boon to growers in Oklahoma with weedy amaranth infestations, and a problem for at least one vegetable amaranth enthusiast. In 2015 it was probably present, but not a problem in our amaranth field in Iowa.

Our crops performed well in a study of adaptation for agricultural green roofs in New York, NY (Aloisio et al. 2016). Both vegetable *Portulaca* and vegetable *Amaranthus* were included in the study, and were adapted for summer roof conditions. This adaptation may be useful for urban vertical farming.

Chenopodium quinoa:

We planted five accessions of quinoa in the field, unusually late, on July 15, 2015 to study their adaptation to fall conditions. We already have many years of experience with planting quinoa on about June 1, and sometimes earlier. These spring plantings establish and flower well, but fail to set seed. Our seed production is in winter greenhouse conditions, and not in the field. Apparently our hot-humid and long-day summer-field conditions prevent seed set. The July 15 planting flowered from September 1 to September 11, and fortunately set seeds harvested on Oct. 26, 2015; although there were approximately 20% empty seed utricles (blanks). This first fall quinoa harvest in Iowa is a breakthrough that may be useful to Mid-Western and Eastern growers interested in quinoa production. An early-August planting may perform better since the quinoa would flower in mid-September when temperatures are cooler than early September. I think it is no coincidence that the local wild *Chenopodium berlandirei*, which is closely related to quinoa, flowers in late September and October, apparently the optimum flowering time.

Yield from 180 cm long rows of quinoa planted July 15, on 90 cm spacing, and harvested Oct. 26, 2015

Accession	Number of plants	Grams/100 seeds	Grams of seed
Ames 13737	4	0.305	69.903
PI 433232	No emergence		0
PI 510537	14	0.141	77.815
PI 614880	21	0.212	32.352
PI 634919	5	0.263	97.623

One of our *Chenopodium berlandieri* accessions PI 666297 (BYU 803) was successfully crossed with *Chenopodium quinoa* and the F3 generation plants are being genetically characterized at Brigham Young University (Matanguihan et al. 2015).

<u>Taxonomy</u>:
In 2015, David Brenner made 66 taxonomic re-identifications, involving three genera. Of these 54 re-identifications corrected errors dating back to 1984 when the accessions were logged in under *A. hybridus*, then the accepted binomial for what we now recognize as *A. quitensis*.

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 that were inflated with a medical oxygen concentrator of a type that is intended for home use, the bags were sealed for the duration of our eight-day study. Germination increased by about 100% over control samples. A manuscript on this was published in Crop Science during 2015. The same information was presented as a poster for the 2015 American Society of Agronomy meeting in Minneapolis.

In an effort to reduce time and labor spent cleaning small seeds, David Brenner modified a vibratory deck seed cleaner that was already in development here in 2014. An ERIZ model 6-C vibrator was purchased by the station and outfitted with wood and plywood gear. The most effective deck for *Melilotus* seed cleaning was constructed of plywood, and surfaced with glued-on 100 grit sandpaper. This device was used by our crew of student workers to clean approximately 40 *Melilotus* seed lots, and dramatically speeded the process.

Our difficult-to-thresh materials are generally threshed by hand rubbing with rubber blocks on a rubber surface. David improved seed threshing by constructing a parabolic basin 65 cm wide 7 cm deep and lined with a textured rubber mat. This basin improves on the rubber-lined 35 by 19 cm boxes that we threshed in previously because the new threshing basin allow for larger sweeping arm motions.

Figure 2. A vibratory deck seed cleaner with newly constructed wooden and plywood gear built by David Brenner and now in general multi-project seed cleaning use.

Presentations:
David Brenner gave a PowerPoint presentation: Status of the *Amaranthus* Seed Collection at the Amaranth Institute meeting, Chicago, Illinois, September 24 to 26, 2015, and a poster (Brenner et al. 2015b) about using concentrated oxygen gas to release seed dormancy. David also moderated a session of oral papers at the 2015 American Society of Agronomy conference.

On March 11, 2015 The Iowa State University NREM 305 Wild Edibles Class was given a tour of the campus greenhouse by David Brenner. The tour featured edible wild plant species growing in the greenhouse. The class was also given a demonstration of winnowing amaranth grain with wind provided by an electric fan.

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 its features.

Visitor from China:
Ms. Xiaohan Lyu (Kelly) from the Hangzhou Academy of Agricultural Science (HAAS) in China visited to imlearn new methods and skills applicable to quinoa germplasm, and especially to learn about growing quinoa for greenhouse seed increase. She was with us from Nov 10 to 20, 2015. Her visit included traveling to the American Society of Agronomy meeting in Minneapolis, MN. David met her in 2014 when her quinoa research group sponsored David's travel to China.

Manuscript Review:
David Brenner reviewed one manuscripts for an external organization.

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).

Service:
David serves on the Board of the Amaranth Institute. Also in early 2016 David was elected as Crop Science Society of America, Division C-8 Chair-Elect which progresses to service as Division Chair-Elect in 2017, Division Chair in 2018, and Past Chair in 2019.

Conclusions and Plans for 2016 and 2017:
We will have a *Coriandrum* planting in 2016 since new viability data indicates that some distribution seed lots have declining viability.

David Brenner will make an oral presentation about new *Amaranthus* research publications at the Amaranth Institute meeting. He is also preparing a Plant Exploration grant proposal to collect *Amaranthus*, *Setaria*, and *Echinochloa* near Tampa Florida in October 2017, as part of a trip to attend an American Society of Agronomy meeting. David is working with others to write a book chapter on North American Crop Wild Relatives of the cereal and pseudo cereal crops.

The next Amaranth Institute meeting is planned for August 3-5, 2016 in Nashville, Tennessee, hosted by Matthew Blair's amaranth research group at Tennessee State University. The 2017 amaranth meeting may be held in Africa.

Research publications derived from use of NC7 germplasm or associated information:
Aloisio, J.M., Tuninimga, A.R., and Lewis, J.D. 2016. Crop species selection effects on stormwater runoff and edible biomass in an agricultural green roof microcosm. Ecological Engineering. 88:20–27. doi:10.1016/j.ecoleng.2015.12.022.

Bazile D., Bertero, D., and Nieto, C. eds. 2015. State of the art report of quinoa in the world in 2013. FAO & CIRAD. 590 pg. http://www.fao.org/3/a-i4042e/i4042e00.pdf.

Blair, M.W., Edwards, M., Thapa, R., Bekari, K., and Brenner, D. Evaluation and development of an F2 mapping population of Amaranthus for herbicide tolerance and other traits. Poster at: The Amaranth Institute meeting, Chicago, Illinois, September 24–26, 2015.

Brenner, D.M., Dekker, J., Niemi, J., and Pfiffner, L. 2015a. Medical oxygen concentrators for releasing seed dormancy. Crop Science. 55:2291–2293. doi: 10.2135/cropsci2014.11.0783.

Brenner, D.M., Dekker, J., Niemi, J., and Pfiffner, L. 2015b. Releasing seed dormancy with oxygen Concentrated by medical equipment. Poster number 911. American Society of Agronomy annual meeting, November 15–18. Minneapolis, MN. https://scisoc.confex.com/scisoc/2015am/webprogram/Paper91808.html.

Brown, D.C., Cepeda-Cornejo, V., Maughan, P.J., and Jellen, E.N. 2015. Characterization of the *Granule-Bound Starch Synthase 1* gene in *Chenopodium*. The Plant Genome. 8:1–12. doi: 10.3835/plantgenome2014.09.0051.

Buttala, L., and Siegel, S., editors. 2015. The Seed Garden. Seed Savers Exchange. Decorah, IA. http://www.seedsavers.org/the-seed-garden-the-art-practice-of-seed-saving.

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

During 2015, Jeff Carstens continued as curator working with the NC7-woody landscape collection with focus towards *Aronia*, *Betula*, *Cornus, Fraxinus* and, *Gymnocladus*. Dan Barney continued as curator of the NC7-medicinals, mints, and herbaceous ornamentals collections. Dr. Barney's focused efforts towards developing five-year management and acquisition plans for high- and medium-priority taxa and accessions and completed seed dormancy and germination research that was initiated in 2012. On October 31st, Dr. Barney retired leaving all three collections under the curation of Jeff Carstens. In November 2015, Nickolis Ouellette was hired as the Horticulture Technician to assist with all technical activities with the horticulture project.

Table 1. Taxa with active accessions maintained in the NC7 horticulture collections as of December 31, 2015.

Management group	Genera	Subgeneric taxa	Accessions
NC7-medicinals	33	197	956
NC7-ornamentals	51	245	720
NC7-woody landscape	95	383	1865
Total	**179**	**825**	**3541**

Acquisitions:
During 2015, we added no medicinal, 1 herbaceous ornamental accession, and 54 woody landscape accessions to the horticulture collections.

Collection trips were completed by Jeff Carstens in Oklahoma, Arkansas, and Missouri sampling *Cotinus obovatus* (7); Iowa sampling *Betula* spp. (6 accessions), *Malus ioensis* (2), *Amelanchier* sp. (1), *Fraxinus* spp. (3), *Hamamelis virginiana* (1), *Viburnum opulus* var. *americanum* (1) and *Spiraea alba* (1); Texas, Michigan, Oklahoma, Missouri, and Arkansas sampling *Gymnocladus dioicus* (17).

Significant contributions from other cooperators include *Fraxinus pennsylvanica* (2) from Joseph Zeleznik (North Dakota State University); *Fraxinus* spp. (7) from Kevin Conrad (Woody Landscape Crop Germplasm Repository) and Michael Dosmann (The Arnold Arboretum of Harvard University) and Joseph Rothleutner (The Morton Arboretum); *Aronia* spp. (8) from Mark Brand (University of Connecticut); *Cornus florida* (1) from Sally Weeks (Purdue University); *Fraxinus quadrangulata* (1) from Steve Bieberich (Sunshine Farm & Nursery); and *Staphylea trifolia* (1) from Andrew Schmitz (The Brenton Arboretum).

Maintenance:
To facilitate and streamline management, accessions in the NC7-mints collection were reassigned to either the NC7-medicinals or NC7-ornamentals maintenance groups, depending on their primary usage.

Existing plantings of *Actaea*, *Anemone*, *Echinacea*, *Hypericum*, *Monarda*, *Origanum*, and *Prunella* were maintained and harvested, as were two new *Calendula* accessions for the medicinals and ornamentals collections. We established 16 *Hypericum* accessions in containers representing three species. The perennial *Hypericum* accessions will be overwintered in containers inside the cave pending spring field planting.

Maintenance efforts for woody-landscape accessions continued in 2015 with 35 accessions transplanted to the field including *Aesculus, Aronia, Betula, Cornus, Diervilla, Hydrangea, Spiraea, Ulmus,* and *Viburnum*.

<u>Availability and Backup</u>:
At the end of 2015, approximately 72% of the medicinals collection was available. For the herbaceous ornamentals collection, 75% of the accessions were available. These numbers differ from previous years largely due to merging of the NC7-mints accessions and transfer of the complete NC7 *Baptisia* collection to the Ornamental Plant Germplasm Center in Ohio, as well as the receipt of a large number of accessions

through the Seeds of Success program. For the woody landscape collection, 52% of the accessions were available, an increase of 1% from the year before.

For the medicinals and ornamentals accessions, 77% and 75%, respectively, were backed up as of the end of 2015, while 42% of the woody landscape accessions were backed up.

Regeneration:
For the NC7-woody landscape collection, we made a total of 44 harvests from *Aronia, Euonymus, Staphylea, Diervilla, Prinsepia,* and other miscellaneous taxa. We attempted to establish 51 accessions including *Cornus alternifolia, Betula* spp., *Diervilla lonicera, Aronia* spp., and *Viburnum opulus* var. *americanum*.

For the medicinals and ornamentals collections, we made a total of 34 harvests from *Actaea*, *Anemone*, *Calendula*, *Echinacea*, *Monarda*, *Origanum*, and *Prunella*. Efforts to regenerate three *Hyoscyamus* and one each *Glebionis* and *Thalictrum* accessions were unsuccessful. The *Thalictrum* accession was retained for further attempts and the other accessions were inactivated. Efforts to regenerate several annual *Hypericum gentianoides* accessions were unsuccessful due to failure of most of the plants to flower.

Viability Testing:
A total of 230 seed viability assessments were made for the woody landscape, 75 for the medicinals, and 7 for the herbaceous collections. A significant understanding of the longevity of *Betula* spp. was achieved by documenting that viability of seeds stored at 4C is short-lived. Maintenance assessments for 30 samples of *Echinacea* held at 4C documented acceptable germination levels (e.g. 60% viable or higher) for 15 year old samples.

In collaboration with the NLGRP, approximately 10,000 or more seeds from three accessions of woody taxa with orthodox seed type are being deposited for long term viability testing. The goal is to determine the longevity under two storage conditions, LN2 and conventional freezer storage. Longevity data for many woody taxa is not known or poorly documented. This information should facilitate future curatorial decisions. To date a total of 36 accessions including *Abies balsamea* (1), *Aronia arbutifolia* (3), *Betula alleghaniensis* (3), *Betula papyrifera* (3), *Betula pumila* (1), *Betula nigra* (3), *Cephalanthus occidentalis* (3), *Cornus alternifolia* (2), *Diervilla lonicera* (3), *Euonymus atropurpureus* (1), *Euonymus europeaus* (2), *Fraxinus quadrangulata* (1), *Gymnocladus dioicus* (1), *Hydrangea quercifolia* (3), *Physocarpus opulifolius* (2), *Pinus strobus* (3), and *Ulmus parvifolia* (1) have been deposited.

Distribution:
Distribution figures for the horticulture collections are summarized in Table 2 and 3, below, and Appendix Table 3. For the combined horticulture program, we distributed 155 external domestic and foreign orders to 125 requestors totaling 631 items from 440 accessions. We cancelled 215 orders from 192 requestors representing 748 items. Most of the orders were cancelled because they were requested for home gardening or other non-research use.

Table 2. Taxa most in demand from the NC7 horticulture program during 2015 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	*Calendula officinalis*	*Monarda fistulosa*
	Origanum vulgare	*Echinacea purpurea*
	Monarda fistulosa	*Echinacea angustifolia*
	Echinacea purpurea	*Echinacea pallida*
	Echinacea pallida	*Hypericum perforatum*
Ornamentals	*Alcea rosea*	*Alcea rugosa*
	Plectranthus scutellariodes	*Alcea rosea*
	Alcea rugosa	*Alcea nudiflora*
	Sanvitalia procumbens	*Sanvitalia procumbens*
	Althaea officinalis	*Plectranthus scutellariodes*
Woody landscape	*Gymnocladus dioicus*	*Aronia melanocarpa*
	Aronia melanocarpa	*Gymnocladus dioicus*
	Spiraea alba	*Quercus prinoides*
	Diervilla lonicera	*Spiraea alba*
	Rhus copallinum	*Rhus copallinum*

Table 3. External domestic and foreign germplasm distributions for the NCRPIS horticulture program during 2015.

Crop	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accs Distributed
Medicinals**	2011	47	45	125	91
	2012	32	29	166	97
	2013	31	30	150	94
	2014***	21	18	133	87
	2015	39	39	218	174
	Average	34	33	158	108
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
	2015	N/A	N/A	N/A	N/A
	Average	26.8	26.2	90.8	58.6
Ornamentals***	2011	114	95	599	405
	2012	49	48	106	86
	2013	45	41	190	154
	2014***	41	40	186	160
	2015	21	20	78	74
	Average	54	49	232	175
Woody Landscape*	2012	47	43	166	131
	2013	76	63	265	186
	2014***	73	58	230	139
	2015	95	66	335	191
	Average	73	58	249	162

* 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.
** During 2015, all NC7-mints accessions were reassigned to either the NC7-medicinals or NC7-ornamentals collections.
*** Decreased distributions beginning 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 2015, seven *Baptisia* accessions were taxonomically re-identified following recent changes in that genus's taxonomy. Twelve NC7-medicinals and ornamentals accessions received PI numbers.

During 2015, no woody landscape accessions were renamed based on morphological characteristics.

Evaluation:
Descriptor lists for *Monarda*, *Origanum*, and *Potentilla* were developed at NC7 and approved by the Medicinal and Essential oils Crop Germplasm Committee (MEOCGC) or Herbaceous Ornamentals Crop Germplasm Committee (HOCGC). Those descriptor

lists, plus descriptor lists for *Actaea*, *Hypericum*, and *Prunella* developed and approved in 2014, were uploaded to GRIN.

In 2015, a total of 508 observations were collected on woody landscape accessions and were loaded into GRIN. Observations focused on seed measurements of *Fraxinus* and *Gymnocladus* and also fatty acid and essential oil contents of *Gymnocladus*.

Enhancement:
No enhancement activities were conducted on the NC7-medicinals, NC7-ornamentals, or NC7-woody landscape collections in 2015.

Coordination of the NC-7 Regional Ornamental Trials:
In 2015, Jeff Carstens distributed 63 plants of three *Prunus hortulana* accessions to eight sites for long-term evaluation.

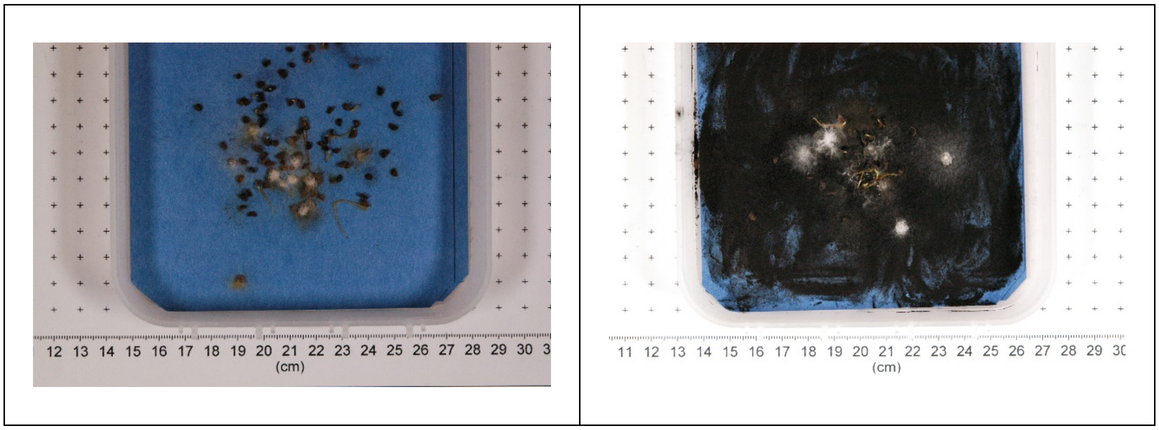
Long-term management plans:
Dan Barney developed a five-year management plan for the NC7-medicinals and ornamentals collections. The plan emphasizes management of high- and medium-priority accessions and includes acquisition recommendations, management strategies, and suggested seed increase schedules through 2020. The goal of the plan 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.

Research products:
The following summarizes research conducted by Dan Barney at NCRPIS during his tenure from 2012 through 2015.

<u>*Actaea* Seed dormancy, germination, surface sterilization and viability assay trials</u>:
Actaea racemosa demonstrates double dormancy and requires both warm and cold stratification. The seeds are highly prone to microbial growth during warm stratification in petri dishes or germination boxes, even when the blotter paper and container are sterile. Germination tests are complicated by the double dormancy and high incidence of pathogen growth in the germination containers.

Efforts to surface sterilize *A. racemosa* seeds using sodium hypochlorite bleach (Clorox) and 3% or 30% hydrogen peroxide proved ineffective. While the hydrogen peroxide reduced mold problems, it also damaged or killed the *Actaea* seeds, which have a rather spongy outer layer that both harbors pathogens and soaks up sterilizing compounds.

Attempts to reduce or eliminate microbial growth by immersing the *Actaea* seeds in activated charcoal proved ineffective. Microbial growth developed, despite the charcoal covering.



Actaea seeds. Controls (let) and charcoal treatment (right). Charcoal covering failed to inhibit microbial growth.

Sowing seeds in peat moss-based potting soil (Sunshine mix No. 1) was effective for *Actaea* germination (emergence) tests. For emergence tests, the seeds were sown in 5.25-inch germination dishes three-fourths filled with moist, screened potting soil. The germination dishes were warm stratified for 30, 60 or 90 days at 15 or 20°C, followed by 30, 60 or 90 days at 5°C and germination with a germination protocol of 25/10°C D/N with 12-hour photoperiod.

Actaea racemosa seedlings after 49 days in a germination chamber following stratification.

Because of the long time period needed for a germination test and practical difficulties in counting germinated seeds in the potting soil, germination tests to determine *Actaea* seed viability are problematic. Barney evaluated the use of 2,3,5-triphenyl tetrazolium chloride (TTC or TZ) to assay seed viability in *Actaea racemosa*. The TTC reacts with enzymes found in cells to form a red pigment. Theoretically, cells that are alive appear red under a microscope, those that are dead appear brown or otherwise unstained. While the test is not infallible, it is useful in determining if a seed embryo is alive.

The *Tetrazolium Testing Handbook* calls for 8-12 hours of incubation in 0.1% TTC for Ranunculaceae, with seeds split longitudinally either completely or partially. The 8-12 hour window, however, does not fit into a normal workday.

Barney tested several concentrations of TTC (0.1%, 0.5%, and 1.0%) with immersion periods of 4 hours or 24 hours using both intact seeds and those split longitudinally for three-fourths of their length. These tests were performed in conjunction with surface sterilization tests, which provided a supply of undamaged seeds, seeds suffering some damage, and seeds that had been completely killed.

<u>*Actaea* research summary</u>:

1. Warm stratification at 15°C or 20°C for 30, 60, or 90 days is effective in breaking radical dormancy.
2. Cold stratification at constant 5°C for 90 days is effective in breaking hypocotyl dormancy.
3. A germination protocol of 25/10°C D/N with 12-hour diurnal period provides acceptable germination of stratified Actaea racemosa seeds.
4. Surface sterilization with hydrogen peroxide or Clorox is ineffective in preventing seed molding and reduces seed viability. Covering the seeds with activated charcoal inside germination boxes is also ineffective in preventing microbial growth.
5. Stratifying and germinating seeds in peat moss-based Sunshine Mix No. 1 potting soil nearly eliminates visible microbial growth on seeds and potting soil.
6. Many of the seeds warm stratified for 90 days and cold stratified for 90 days exhibited radical emergence and had formed roots ca 1-15 mm long prior to being placed into the germination chamber. Differences between accessions in root growth upon removal from cold stratification were apparent.
7. For routine seed viability evaluations, Barney recommends using TTC to evaluate Actaea racemosa. The preferred method is to split the seeds longitudinally for ¾ of their length and immerse them in 1.0% TTC in deionized or distilled water for 24 hours with constant agitation on a tube rotator. The immersion vials should be wrapped in aluminum foil to exclude light, which will cause the TTC solution to turn red and mask treatment effects.
8. For regeneration, Barney recommends sowing the seeds in containers large enough to grow the plants to transplant size, preferably 4 x 4 x 6-inch or larger. Transplanting germinated seeds or small seedlings produces a low success rate with A. racemosa. Warm stratify in moist peat moss-based potting soil at 15 to 20°C for 30 days, followed by 90 days stratification at 5°C. Germinate under alternating temperatures of about 25/10°C D/N. Light is not required for germination.

<u>*Calendula officinalis* seed storage and light trials</u>:
Barney continued studies on the effects of storage conditions on *Calendula officinalis*, which were begun by Dave Kovach at NCRPIS in 2007. The trials evaluated the effects of storage at room temperature or 5°C and germination in the light or dark. The seeds were harvested in 2007 and stored until 2008. Germination tests were conducted previously after 6, 12, 18, 24, 30, 36, and 42 months of storage. In March 2014, Barney conducted a 6-year (72 month) test. Sufficient seeds remain in the seed storage laboratory and north cold room to continue these trials. It is recommend that the seeds be retested in March 2020 (12 years), March 2026 (18 years) and, hopefully, in further 5- to 10-year intervals.

Calendula summary:
In summary, germination percentages climbed from six-month storage levels and maximum germination percentages occurred about 24 months after harvest for both room temperature and cold storage. Consistently over the 6-year period, seeds stored at room temperature produced equal or higher germination percentages than did seeds in cold storage. Seeds germinated in the dark at higher percentages than they did in the light with a 25/10°C 12-hour photoperiod protocol.

Barney recommends that the trials continue with the existing seed lots and also that tests be conducted on the effects of storing *Calendula* seeds at -18°C for long-term storage.

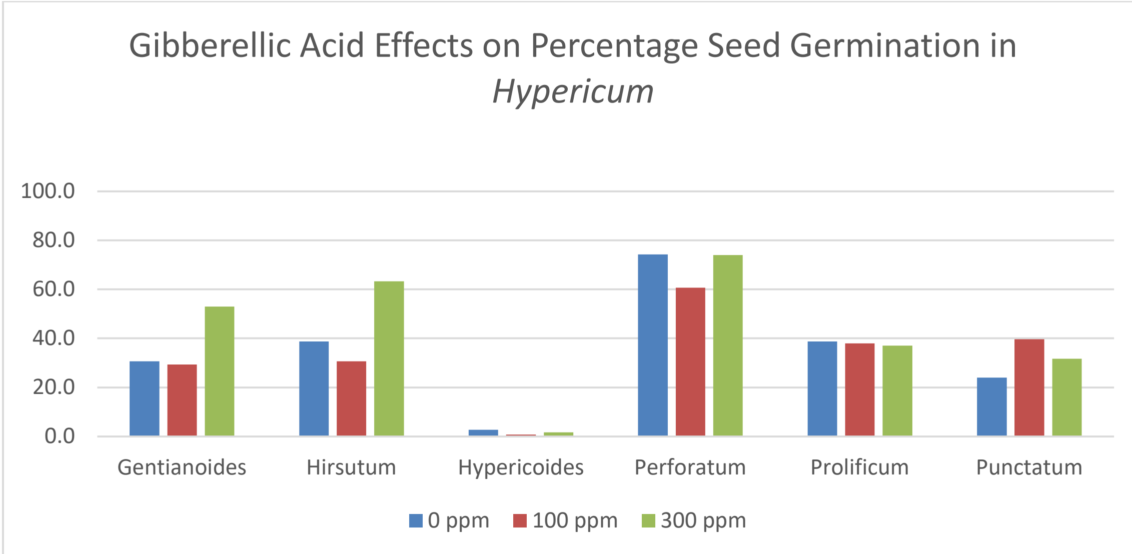
Hypericum seed dormancy, germination, and surface sterilization trials:
Barney conducted much work with *Hypericum* related to dormancy, germination temperatures, desiccation for storage, cold stratification, gibberellic acid, fungicide treatments, and surface sterilization.

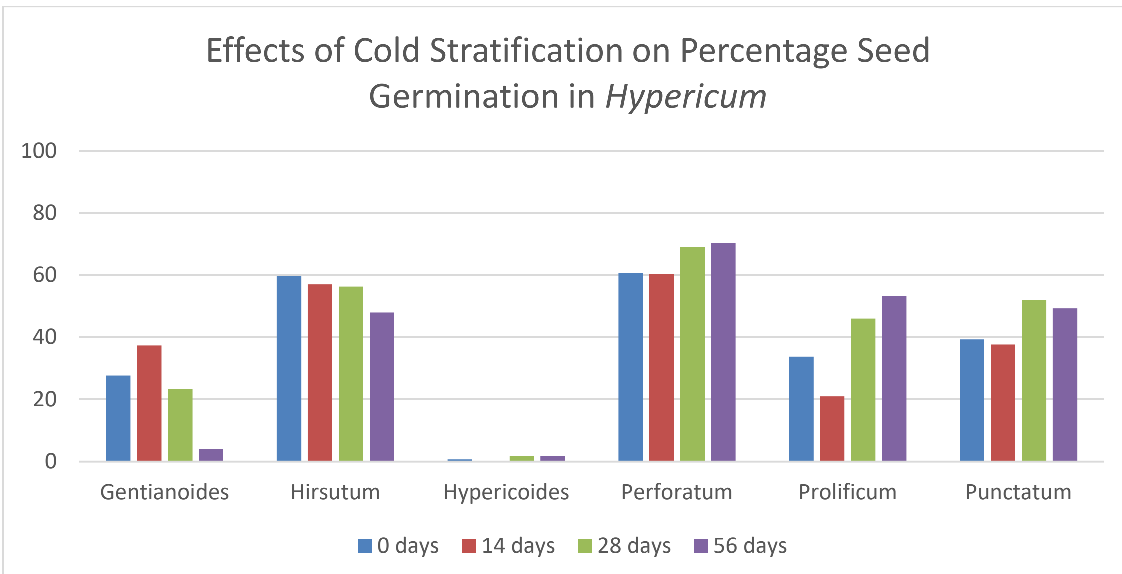
Hypericum temperature versus germination trials: Cumulative germination was compared for seeds germinated at constant 20°C or 30/20°C D/N with 12-hour photoperiod. Five of the eight species tested produced higher germination under an alternating 30/20°C protocol than at a constant 20°C. Results are summarized in the chart below showing the highest cumulative germination achieved for each species.

Mean cumulative germination for the accession producing the highest germination for each species, germinated at a constant 20°C or under an alternating 30/20°C protocol.

Species	**# of accessions tested**	**Mean for accession**	**20°C**	**30-20°C**
H. androsaemum	3	PI 618712	82.7	93.9
H. bithynicum	2	Ames 29127	49	17.3
H. gentianoides	3	PI 664838	0.5	15.2
H. hirsutum	3	PI 649052	56.9	47.3
H. hypericoides	3	Ames 28428	6.6	21.2
H. perforatum	3	PI 664840	76.3	81.8
H. prolificum	3	PI 664868	48.4	40.8
H. punctatum	3	Ames 28352	34.9	42.5

Hypericum cold stratification and gibberellic acid trials: The effects of cold stratification and soaking seeds in a gibberellic acid solution on germination percentages were studied for six high- or medium-priority taxa. *Hypericum hypericoides* has proven difficult, germinating poorly or not at all in most tests. During the temperature tests in 2013, one accession of *H. hypericoides* germinated at 21%, but this degree of germination was not observed again. In tests of cold stratification and gibberellic acid, controls of the same accession produced no greater than 0% to 4% germination. The other two accessions tested consistently produced little or no germination in all tests. It is not yet known whether all the seed lots are inviable or whether the protocols used are ineffective. More germination work is needed for this species.

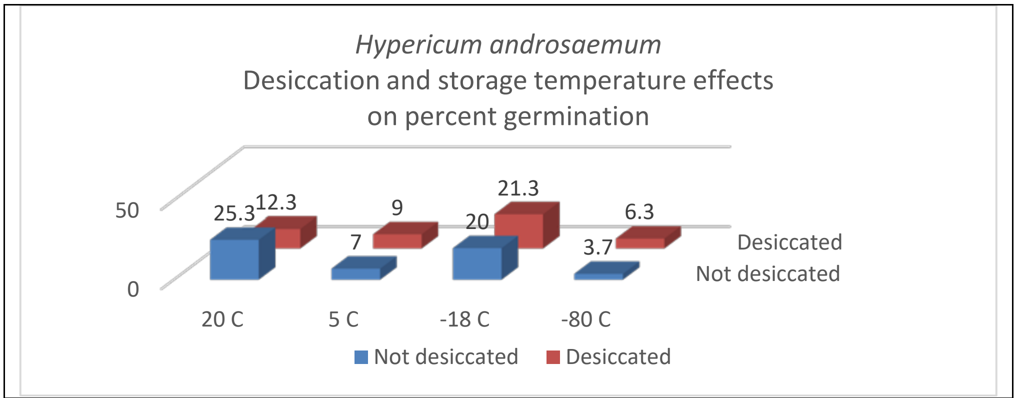


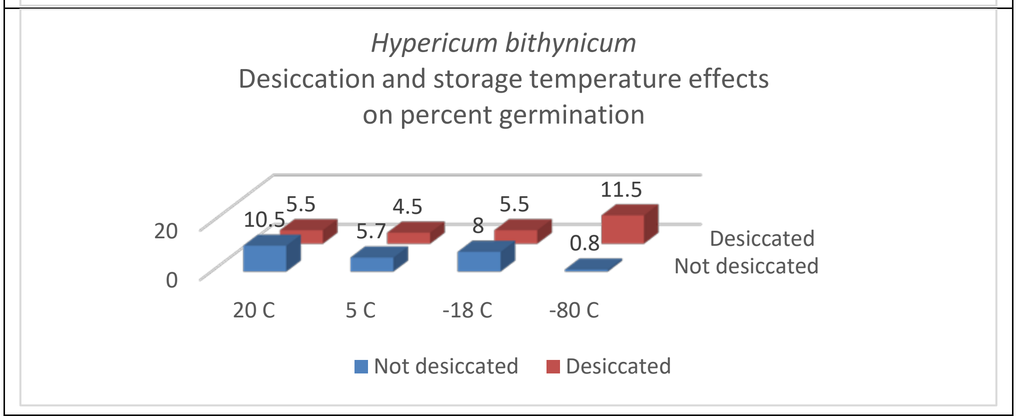


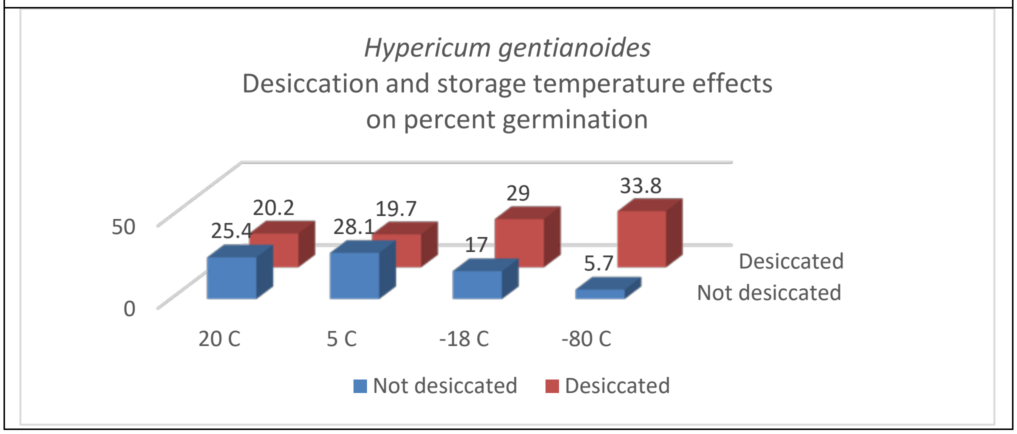
Hypericum seed surface sterilization trials: Quite typically, a high percentage of germination dishes containing *Hypericum* seeds produce moderate to extremely heavy microbial growth which quickly destroys the seeds and/or makes counting germination difficult. Unfortunately, attempts to reduce microbial growth in germination dishes by treating seeds with insecticidal soap, ethanol, liquid sodium hypochlorite bleach, liquid sodium dichloroisocyanurate (NaDCC), chlorine gas, and hydrogen peroxide were ineffective. Either the treatments did not reduce microbial growth or they damaged or killed the seeds and reduced or eliminated germination.

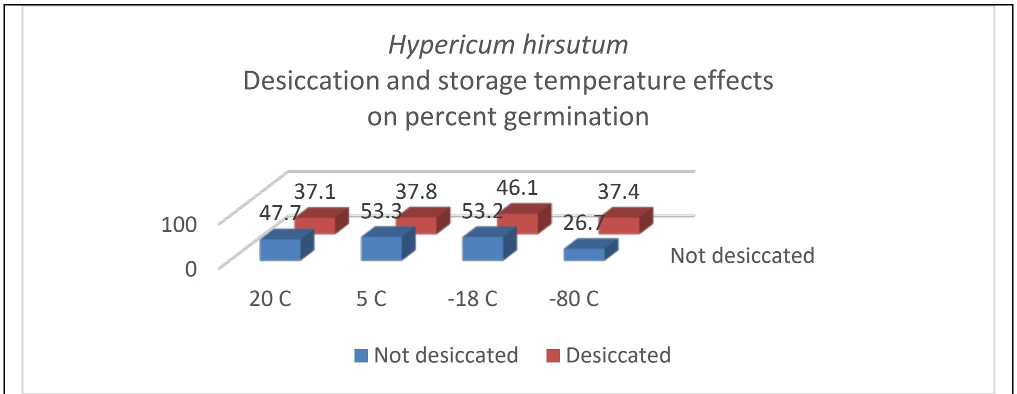
Hypericum seed fungicide treatments: Fungicide tests were conducted using two accessions of *H. perforatum*. Treatments included water controls and Allegiance, Banrot, Bravo, or Quadris fungicides. One accession germinated poorly, regardless of protocol, while the second produced high germination rates for most treatments. The Bravo treatment eliminated microbial growth, but also all germination. The Banrot treatment shows good potential, with little or no effect on the higher germinating accession and increasing germination to about 49% germination in the lower-germinating accession, compared with 2.8% germination in controls. Further work with Banrot using other *Hypericum* species and fungicide concentrations is recommended.

<u>*Hypericum* seed desiccation and storage temperatures</u>: *Hypericum* seed samples taken from cold storage and representing a variety of taxa were desiccated or left undesiccated and stored at room temperature, 4, -18, or -80°C for two years. The various taxa did not all respond uniformly to the treatments. Desiccation generally had little or no effect on germination percentages at non-freezing temperatures, but for some taxa, significantly improved germination for samples frozen at -18 or -80°C. Results are shown in the graphs below.

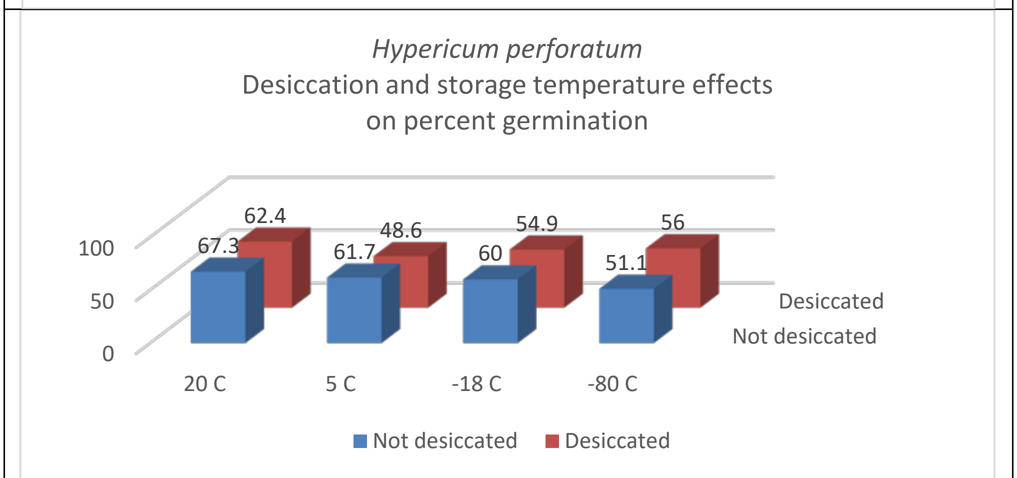




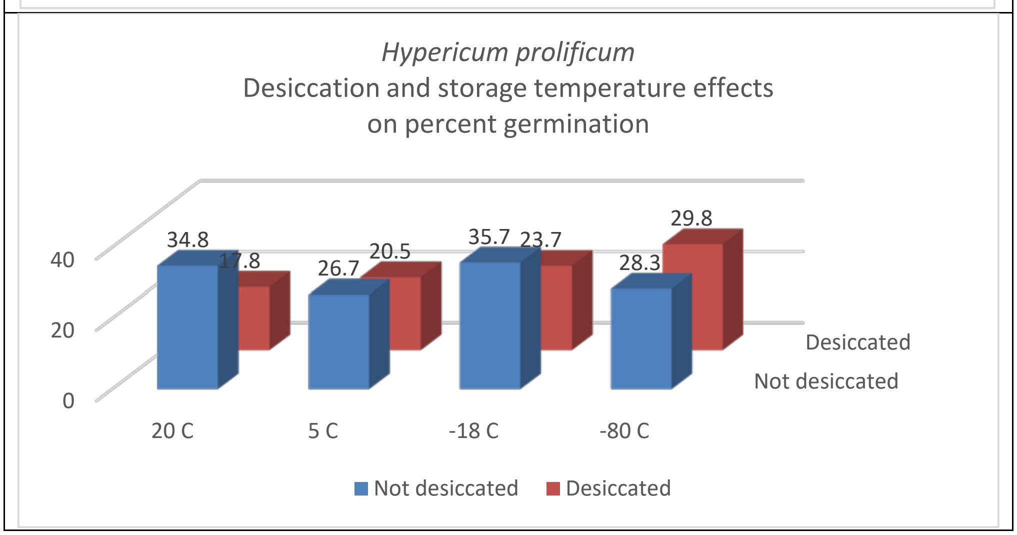




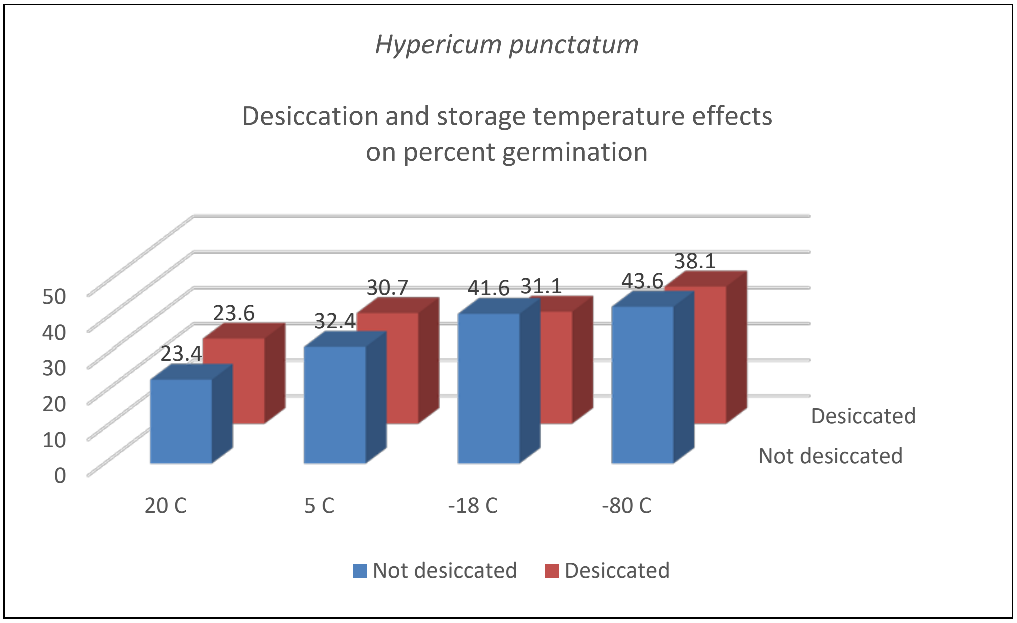
Hypericum hirsutum
Desiccation and storage temperature effects
on percent germination
100
0
47.7
37.1
53.3
37.8
53.2
46.1
26.7
37.4
20 C
5 C
-18 C
-80 C
Not desiccated
Not desiccated
Desiccated



Hypericum perforatum
Desiccation and storage temperature effects
on percent germination
100
50
0
67.3
62.4
61.7
48.6
60
54.9
51.1
56
20 C
5 C
-18 C
-80 C
Desiccated
Not desiccated
Not desiccated
Desiccated



Hypericum prolificum
Desiccation and storage temperature effects
on percent germination
40
20
0
34.8
17.8
26.7
20.5
35.7
23.7
28.3
29.8
20 C
5 C
-18 C
-80 C
Desiccated
Not desiccated
Not desiccated
Desiccated



<u>*Hypericum* summary</u>:

1. Seed coat inhibitors affect germination in *H. perforatum* and other taxa.
   a. Soaking the seeds for 24 hours in tap water or deionized water with constant agitation on a tube rotator removes the inhibitor prior to germination tests.
   b. In the greenhouse, sowing the seeds onto firm, moist potting soil and irrigating heavily and frequently with light mist for the first 24 hours removes the seed coat inhibitors.
2. Optimum germination temperatures differ among the various taxa. For the *Hypericum* taxa tested so far, the recommended protocols are:
   a. Constant 20°C with 12-hour light and dark periods.
      i. *H. bithynicum*, *H. hirsutum*, *H. prolificum*
   b. Alternating 30/20°C D/N with 12-hour photoperiod.
      i. *H. androsaemum*, *H. gentianoides*, *H. hypericoides*, *H. perforatum*, *H. prolificum*.
3. Pretreating seeds with a 300 ppm gibberellic acid solution increases seed germination percentages for some taxa, but not others.
   a. Taxa benefitting from GA pregermination treatments.
      i. *H. gentianoides* and *H. hirsutum*.
   b. Taxa that do not benefit from GA pregermination treatments.
      i. *H. perforatum*, *H. prolificum*, and *H. punctatum*.
4. Cold stratification for 28 days increases germination rates for some taxa, but not others.
   a. Taxa benefitting from 28 days stratification at 5°C.
      i. *H. prolificum* and *H. punctatum*.
   b. Taxa that do not benefit from 28 days stratification at 5°C.
      i. *H. gentianoides*, *H. hirsutum*, and *H. perforatum*.
5. Microbial growth in germination containers remains a serious problem in Hypericum viability testing.
   a. Surface sterilization proved ineffective.
   b. Pregermination treatment with the fungicide Banrot shows promise.

c. Fortunately, most Hypericum seeds germinate within 14 days of sowing, typically before microbial growth and seed damage become too extreme to make accurate counts.
d. Some of the microbe species observed in the germination dishes were extremely aggressive and quickly destroyed both dead and live seeds, making the "squish test" to identify live but dormant seeds ineffective in many cases.

6. Seed storage - Different taxa have different optimum storage optimums in terms of desiccation and storage temperatures. Barney's recommendations are:
   a. *Hypericum androsaemum* – Store seeds at -18°C. Do not desiccate.
   b. *Hypericum bithynicum* – Store seeds at -18°C. Do not desiccate.
   c. *Hypericum gentianoides*
      i. Store seeds for distribution at 5°C. Do not desiccate.
      ii. For long-term storage of nondistribution lots, store desiccated seeds at -18°C.
   d. *Hypericum hirsutum* – Store seeds at -18°C. Do not desiccate.
   e. *Hypericum perforatum* – Store seeds at -18°C. Do not desiccate.
   f. *Hypericum prolificum* – Store seeds at -18°C. Do not desiccate.
   g. *Hypericum punctatum* – Store seeds at -18°C. Do not desiccate.

Echinacea biochemistry:
This collaborative project between the NCRPIS and the University of Louisiana Monroe began as a Specific Cooperative Agreement (SCA 58-3625-3-728) in 2013, with no-cost extensions of ARS funding for 2014 and 2015. The project title is ***Optimization of Echinacea spp. medicinal activity utilizing source-identified germplasm curated at the North Central Region Plant Introduction Station***. The ULM principal investigator was Dr. Sharon A. Meyer, University of Louisiana at Monroe, College of Pharmacy, Monroe, LA. The basis of the project, as taken from the grant proposal, is as follows.

> In an earlier collaboration between the University of Louisiana Monroe and NCRPIS, we demonstrated stimulation of bone marrow progenitor cell production for the myeloid lineage (GM-CFCs) to be nearly equivalent for a commercial Echinacea supplement and aerial parts of accession E. purpurea PI 649040. The work demonstrated that the herbal supplement activity was due to phytoconstituents, rather than non-plant additives. The newly proposed studies will demonstrate whether potency of PI 649040 is similarly enhanced by lipophilic extraction, as shown for the supplement, and will provide justification for future studies to develop an Echincacea-derived myelostimulatory phytopharmaceutical, in part, by screening NCRPIS germplasm for optimal starting material. We anticipate that an efficacious, plant-derived myelostimulant will have application for treatment of several clinical instances associated with bone marrow failure (BMF), especially acquired BMF as occurs with cancer chemotherapy and myelodysplasia syndromes resulting from occupational exposures to hematotoxicants such as benzene.
>
> Aerial plant materials (stems, leaves, and flowers) from *Echinacea purpurea* PI 649040 will be produced at the USDA-ARS North Central Regional Plant Introduction Station and shipped to the University of Louisiana at Monroe. Upon arrival, the plant materials will be dried, powdered, and macerated with 75% ethanol at room temperature. The ethanol extract will be n-hexane-washed and

the extracts lyophilized and purified using high performance thin layer chromatography (HPTLC). Female rats will receive daily oral doses of 0 – 200 mg/kg of the extract. 24 hours later, bone marrow cells (BMCs) will be plated in 96-well plates in methylcellulose containing colony stimulating factor (CSF2), interleukin-3 (IL-3), and stem cell factor (SCF) (HALO kit, HemoGenix, Colorado Springs, CO). After 5 days, ATP of bone marrow progenitor cells of myeloid lineage (GM-CFCs) will be measured by a luminescence assay. Concurrent chemical analyses will be done with HPTLC and proton nuclear magnetic resonance spectroscopy (1H-NMR).

At conclusion we should have a dataset from *E. purpurea* PI 649040 for direct comparison to that available from plant material used to prepare Echinacea herbal supplement.

The proposed studies are an important extension of previous work in that they lay the groundwork for additional processing steps to optimize bioactivity, again validating against bone fide, taxonomic identified plant material.

Under the agreement, ARS agreed to:
1. Work closely with the cooperator in planning and conducting the research outlined above.
2. Conduct research on the following aspects of the project.
    a. Assist in the identification and selection of appropriate *Echinacea* taxa and accessions.
    b. Produce *Echinacea* plant materials for laboratory trials at ULM.
    c. Enter biochemical profile information provided by ULM for NPGS accessions utilized in the research, and citation of the resulting work into the GRIN database for public access.

 Echinacea angustifolia	 Echinacea angustifolia var. angustifolia
 Echinacea pallida	 Echinacea purpurea

For the project, 18 *Echinacea* accessions representing four taxa were selected and established as both containerized and field-grown plants. During 2014 we harvested from containerized plants only and yields were very low. During 2015, the field plants were large enough to harvest and we collected samples from the field, with an additional harvest from one *Echinacea purpurea* accession from the containerized plants in the shade house. We harvested the flowers and flower stalks down to just below the second leaf from the flower. Stalks were harvested when the flower petals were fully expanded. The accessions used and the 2015 harvest weights sent to ULM were as follows:

Accession	**Seed lot**	**Taxon**	**2015 harvest dry weight (g)**
Ames 30075	09ncao01	Echinacea angustifolia	125.9
PI 421331	10ncai01	Echinacea angustifolia	232.3
PI 597601	00ncai01	Echinacea angustifolia	101.9
PI 649026	06ncai01	Echinacea angustifolia	100.4
PI 421332	06ncab01	Echinacea angustifolia var. angustifolia	177.7
PI 631287	00ncai01	Echinacea angustifolia var. angustifolia	169.8
PI 633654	04ncab01	Echinacea angustifolia var. angustifolia	245.2
PI 649029	07ncab01	Echinacea angustifolia var. angustifolia	119.3
PI 649032	06ncab01	Echinacea angustifolia var. angustifolia	211.7
Ames 28188	06ncai01	Echinacea pallida	135
PI 597603	96ncai01	Echinacea pallida	250.9
PI 631300	02ncai01	Echinacea pallida	341.4
PI 631315	02ncai01	Echinacea pallida	67.4
PI 633661	04ncab01	Echinacea pallida	171.6
PI 631307	00ncai01	Echinacea purpurea	389.6
PI 633668	02ncai01	Echinacea purpurea	229.5
PI 633671	02ncai01	Echinacea purpurea	196.8
PI 649040	06ncai01	Echinacea purpurea - field grown	70.1
PI 649040	06ncai01	Echinacea purpurea - shade house grown	90.3

On 5-28-2015, Dr. Meyer provided the following update on results produced with 2014 harvested material. The main analyses began in September 2015 and results were not available as of the date of this entry.

> We've processed the 2 samples with quantity sufficient to do a full assay, *E. purpurea* 631307 and 633668. We completed rat exposures (oral) on 631307 and are half-way on the other.
>
> For 631307, we see:
>
> 1. 67% increase in bone marrow myeloid progenitor cells (attached excel file)
> 2. A decrease of ~10% in relative liver wt; no effect on body weight or relative spleen weight
> 3. An increase of ~150% in blood granulocytes; no change in red blood cells or hemoglobin

4. A decrease at highest dose (200 mg/kg; 7 d) in serum alkaline phosphatase.

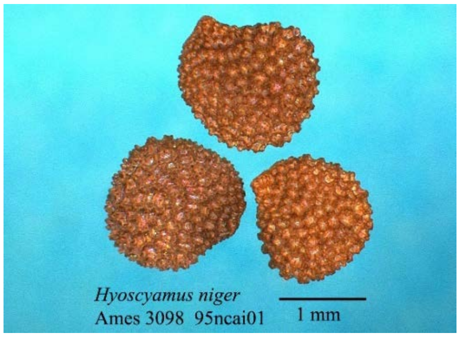
So - although this plant is also myelostimulatory, the magnitude of the effect is not as large as plant material used to make the herbal supplement (~100% inc.; gift from TwinLabs) nor the earlier *E. purpurea* PI 649040. We have enough of the new harvest of PI 649040 to do a rat exposure this summer.

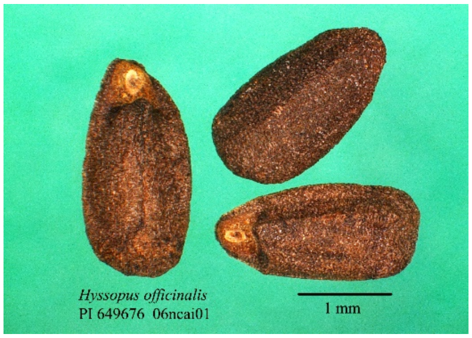
The remaining replications for 633668 will be done in mid-July, 2015.

On 8-6-2015, Barney sent dried and pressed herbarium voucher specimens of all 18 *Echinacea* accessions used in this project to Dr. Robert Webster of the USDA National Arboretum for inclusion in that arboretum. On 8-10-2015, he delivered matching voucher specimens to Dr. Deborah Lewis of the Iowa State University Ada Hayden herbarium, less two accessions that were already in the Ada Hayden Herbarium. The specimens were collected and pressed in June-July 2015 from field- and shade-house-grown plants at NCRPIS.

Seed imaging and training:
During 2015, Dan Barney continued imaging seeds from the NC7-medininals and NC7-ornamentals collections, with the goal of creating a virtual herbarium of seed images for high and medium-priority taxa. Barney also conducted workshops for ARS and Iowa State University employees on creating close-up images. The manual used was *Imaging Methods for High Definition Close-ups of Seeds and Other Plant Parts*, which Barney completed in December 2014. Hands-on workshops to NCRPIS and Iowa State University personnel were provided for flat-bed scanning, microphotography, macrophotography, and image processing.

An imaging center for micro- and macrophotography was established in room G205 of the Agronomy Building on the ISU campus.





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 1. 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.

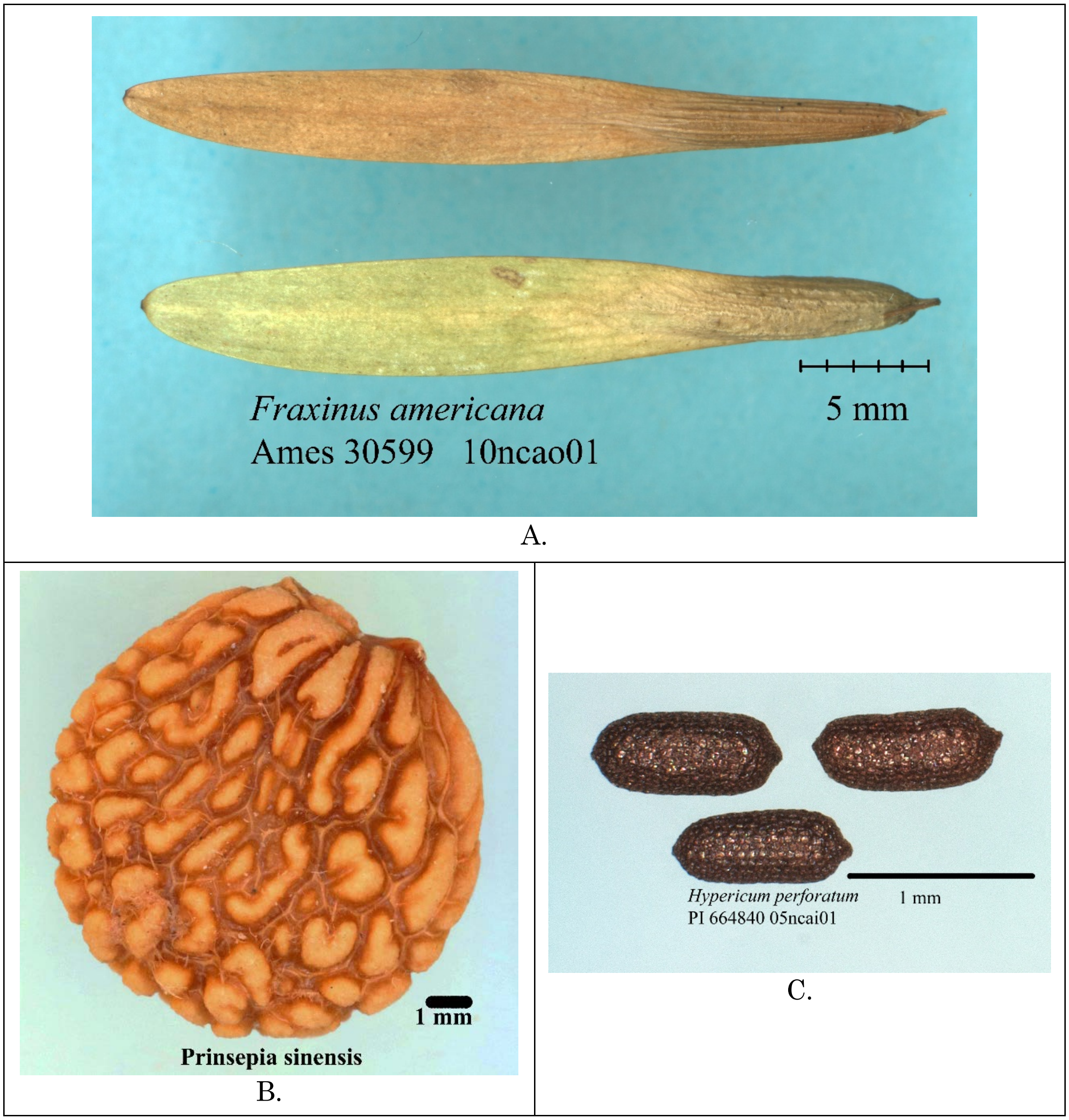


Figure 2. Close-up imaging capabilities at NCRPIS include A) flatbed scanning, B) macrophotography with digital camera and macro lens, and C) microphotography.

Posters, Presentations, and Seminars:

In fall of 2015, Jeff Carstens hosted a tour of the NCRPIS and gave a presentation on the NC7 Regional Woody Ornamental Trials Program for the Mid-American Collegiate Horticulture Society (MACHS) competition to approximately

Conclusions and Plans for 2016:

The 2015 growing season was generally productive in terms of overall regeneration of the horticulture collections. Progress continued in the acquisition and curation of *Gymnocladus, Aronia, Spiraea,* and *Betula* woody landscape germplasm. Future collaboration will involve the evaluation of *Gymnocladus dioicus* accessions with Dr. Joanna Freeland (Trent University). Their plans are to investigate the causes of low recruitment, determine the imitations of reproduction, and develop molecular markers to characterize georeferenced materials.

Curation:
For 2016, we will attempt to obtain seed increases from 21 medicinal and ornamental accessions. We will attempt to obtain seed increases from approximately 50 NC7-woody landscape accessions.

Evaluation:
Evaluation plans for 2016 will focus on the establishment of a replicated evaluation study of *Betula nigra* accessions that were collected from 5 sites in Iowa against two cultivars 'Cully' and 'BNMTF' that are common in the nursery trade.

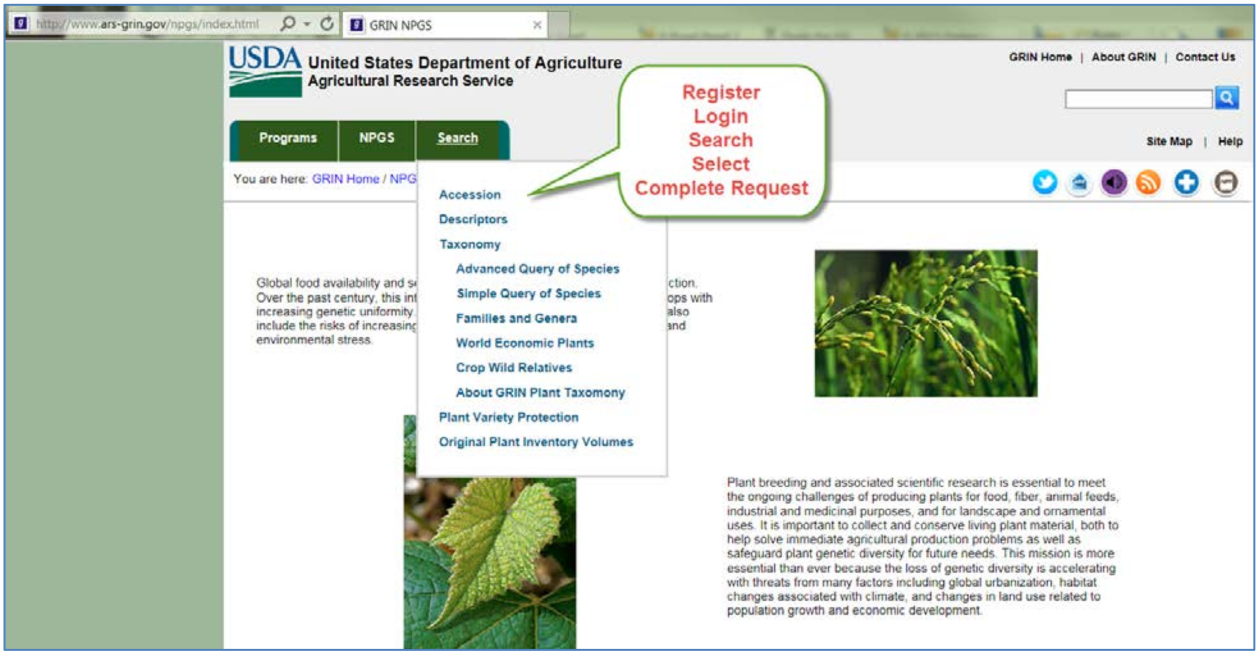
Staff Development:
Jeff attended the Iowa State University Shade Tree Shortcourse at Ames, Iowa.

E. Maize Curation (M. Millard)

Personnel:
The maize curation tech team is again fully staffed. David Zimmerman, a recent graduate of Iowa State University joined the staff in March 2015 as an Iowa State University Ag. Specialist II. As an undergraduate he worked for the ISU Doubled Haploid Facility and for a brief time as a corn breeding technician. Brady North returned to the maize project on November 30, 2015 as a Federal Biological Technician. He replaces Bruce Hall who resigned as federal Agricultural Research Science Technician in December 2014 and left in January 2015. Brady decided maintaining maize collections in Iowa beats guayule breeding in Arizona any day. We are pleased to have Brady back and David is doing an excellent job.

Research Progress:
The NPGS version of GRIN-Global was implemented on November 30, 2015. Go to http://www.ars-grin.gov/npgs/index.aspx as the entry point for GRIN-Global and your old favorites. Many of the GRIN-Classic features have been totally converted. Others will be in 2016.

To request germplasm, the user should register, login, search, make selections and place the order. This will allow much faster processing of the request. By creating a login, the requestor user will be able to monitor the status of requests, see a history of their requests, mark favorites, etc.



Users are encouraged to use the Contact Us button to send feedback directly to the development team. Not all suggestions for improvements will initially be incorporated in GRIN-Global live, but all suggestions will be logged and addressed as the website is continually improved. The GRIN-Global tools used by curators and germplasm management staff should allow for faster data processing. As on current GRIN, real-time availability information on maize collections are presented on the public GRIN-Global website.

The maize curator as part of the GRIN-Global development team continues to provide advice on solutions to GRIN-Global issues including those presented by testing at all NPGS facilities. Several genebanks across the world including Australia, Canada, Czechoslovakia, CIMMYT, CIAT, CIP, Chile, Bolivia, and Mexico to name a few are in the process of learning, evaluating, or have implemented GRIN-Global for their operations. It is hoped now with U.S. NPGS implementation all current and future GRIN-Global installations will in concert continually improve the tools for germplasm maintenance.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Retrieve: Web Search Overview
Click Search Options
And Click Advanced Search
Requesting Germplasm? Or just marking favorites? Register and login!
Accessions: Exclude unavailable With images With NCBI link With genomic data
Accession Collecting Site Search Criteria
Choose Criterion 1: -- Select One -- - Select -
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Add More Criteria
Clear All Criteria
Confused???
Start at Help!
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Choose language English
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Accessions are: With images
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Search Options | Advanced Search
Under actions you can add selections to your request list cart all at once.
LESS TIME CONSUMING ONE AT A TIME ADDS.
Actions...
Select: All, None, Inverse, Highlighted Options: Show 10 items << < 1 - 13 of 13 > >> Export...
Group By: Plant ID Plant Name Taxonomy Origin Material Maintained By Availability
PI 608643 Reids Yellow Dent Zea mays subsp. mays United States, Colorado Seed NC7 Add to Cart
PI 608644 Hall's Corn Zea mays subsp. mays United States, Colorado Seed NC7 Add to Cart
PI 213706 Osterland Reids Yellow Dent Zea mays subsp. mays United States, Iowa Seed NC7 Add to Cart
PI 221870 Reids Yellow Dent Zea mays subsp. mays United States, Missouri Seed NC7 Add to Cart
PI 222319 Red Meadowbrook Reid Zea mays subsp. mays United States, Nebraska Seed NC7 Add to Cart
PI 452058 Reids Yellow Dent Zea mays subsp. mays United States, Illinois Seed NC7 Add to Cart
PI 595375 EXOTIC COMPOSITE Zea mays subsp. mays United States, Nebraska Seed NC7 Add to Cart
PI 595376 HAYS GOLDEN*44 Zea mays subsp. mays United States, Nebraska Seed NC7 Add to Cart
PI 595377 NEBRASKA ROOTWORM SYNTHETIC Zea mays subsp. mays United States, Nebraska Seed NC7 Add to Cart
Ames 23427 A374 Zea mays subsp. mays United States, Minnesota Seed NC7 Add to Cart
PI 607386 BS21(R)C7 Zea mays subsp. mays United States, Iowa Seed NC7 Add to Cart
PI 607387 BS22(R)C7 Zea mays subsp. mays United States, Iowa Seed NC7 Add to Cart
PI 639111 Oh605 Zea mays subsp. mays United States, Ohio Seed NC7 Add to Cart
Show 10 items << < 1 - 13 of 13 > >>

On a personal note, I am very pleased that we have reached this milestone. I know this new system still needs improvement, but now hope that I can put more effort into the maize collections themselves.

Acquisition:
In 2015, 53 new accessions were acquired. These included 13 GEM accessions from the Raleigh location, several of which were older "0100" series releases. One new GEM accession from the Ames location was received. We received seed of the sequenced inbred "W22 (C1; R-r:std) Brink" from Dr. Hugo Dooner. There were 29 expired or soon to be expiring PVPs received. Dr. Sherry Flint-Garcia donated a *Zea* synthetic developed from intermating the NAM parents and teosinte populations. Dr. Flint-Garcia also donated six race inbreds developed by selfing within type accessions of different maize races by Dr. Doebley's group. Dr. Krakowsky donated seed of the North Carolina version of CML343. Dr. Hallauer donated his registration lot of BS39, a race Tusón synthetic adapted to temperate latitudes.

Review of important maize collections not in the NPGS began in 2015. Dr. Martin Bohn (Univ of Illinois) began the review of the maize inbred collection held by Dr. Don White for inclusion in NPGS. Dr. Walter Trevisan arranged to meet with Dr. Brewbaker (Univ of Hawaii) to review his inbred collection.

Review of NCGRP collections not held at Ames began in 2015. A comprehensive listing of 26,411 seed lots held at Fort Collins consisting of 51 groups was sent by NCGRP to the maize curator at the NCRPIS. Each of the 51 groups will be reviewed, starting with the oldest first to see what documentation of the original deposit exists. Where appropriate, seed will be deposited in the Ames collection for distribution and where needed regeneration. Much of this documentation is not digitized. The plan is to do this to make review and attachment to each accession's GRIN-Global records easier.

Regeneration:
The *Zea* program accession regeneration attempts in 2015 were 555 accessions (2.7% of the collection) in 2015 maintaining attempts at the level in 2014 of 555 accessions (2.7%) even though the program was short one tech during most of the year. 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 695 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 259 accessions in 2015. This compares favorably to 247 in 2014 and 141 (2,674 vs. 2,860 vs. 1,612 25-foot rows). The nursery was composed of 43 expired or soon to expire PVPs, 159 non-PVP inbreds, 1 GEM, and 56 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.

   A late start on nursery setup due to an open tech position and a new tech just coming on at the end of March, combined with a late April, and early May just a little too cool and wet in Ames prevented an early maize planting, but a break in mid-May allowed the maize curatorial team to plant a 3rd of the nursery consisting of ex-PVP inbreds on May 13th and the remaining on May 19th, just a week to 10 days later than the NCRPIS average planting date for maize increases. After that, the rest of the season was very similar to the 2014 season with well-timed precipitation and average to cooler temperatures. Drip irrigation was unnecessary and would have been difficult to set up anyway because the soil was almost always wet. Frequent 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. There were no severe wind events, an exceptional year in that respect compared to recent years. The only unusual biotic stress was a very unusually heavy northern leaf blight distribution throughout the nursery. Since pollinations started early and were well distributed throughout the season, harvest followed the same non-pressured cycle assisted by a long fall. Additional help will be dedicated to summer pollinating in the future to enable staff to take a day off periodically; three months of seven days a week does not contribute to retention.

No Stewart's wilt was observed in any increase plots in 2015, as in every year between 2010 and 2015. ELISA testing is still necessary on 2015 Ames increase lots to meet phytosanitary requirements because the state cannot be declared Stewart's wilt free. Cold weather in central Iowa during the past six seasons has been a definite benefit in keeping Stewart's wilt under control. Cool weather during almost all of the growing season and a long fall is giving good quality seed. Test weights of most accessions are very good. This summer's regeneration is rated as above average.

2. Thirty-one GEMs were regenerated by the Ames GEM team for the maize collection.

3. DuPont Pioneer Hi-Bred planted, pollinated, harvested, and is quality testing seed from a nursery of 42 tropical populations planted on Puerto Rico in 2015. The nursery targeted 100 females per population. 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 2015. The nursery targeted 50 females per population of mainly lowland tropical adaptation. Many thanks to all at Monsanto who assist in these large tropical nurseries.

5. In May 2015, a nursery of 21 tropical accessions was planted, then pollinated and harvested. The nursery was received from St. Croix in October 2015 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 January 2016, therefore this nursery was small.

6. 3rd Millennium Genetics was contracted in December 2014 to plant, pollinate, and harvest 42 tropical populations on Puerto Rico. Accessions were from tropical locations of lowland adaption. The nursery was received in April 2015 and has been processed. Nine populations had 100 ears or more processed, with an average

of 57 ears. Of those tested for germination so far, the average germination was 97%. Several had a poor field stand because of poor germination quality NCRPIS seed.

7. 3rd Millennium Genetics was contracted in June 2015 to plant, pollinate, and harvest 42 tropical populations on Puerto Rico, to be grown during their summer off season. Lowland tropical accessions from Central America, Mexico, and Brazil which originated from areas with a similar growing season were planted. These accessions were received October 12, 2015 and await processing.

8. 3rd Millennium Genetics was contracted in September 2015 to plant, pollinate, and harvest 70 tropical inbreds. These were planted on October 30, 2015.

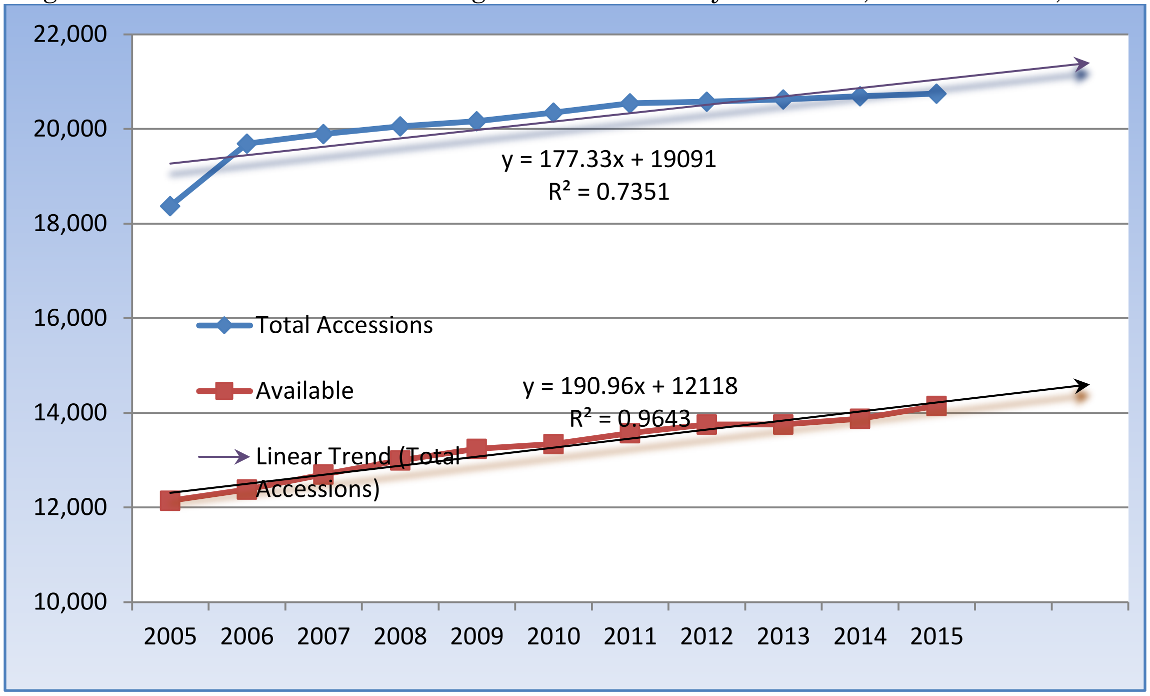
9. Seventeen GEMs regenerated by the Raleigh GEM team in 2015 were received and have been or are being processed at the end 2015

10. Ames greenhouse increases harvested during 2015 included 18 maize accessions. Most of these maize increases are accessions needing a rescue increase from low quantities and/or low viability. One is a short season Tom Thumb grown in isolation. Thirteen accessions were planted at the end of 2015 for harvest in 2016.

Maintenance:
There were 20,744 accession of *Zea* held at the NCRPIS as of December 31, 2015, a small increase over the 20,694 accessions of *Zea* held at the NCRPIS as of December 31, 2014, and 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 101 accessions from the *Coix* and *Tripsacum* genera.

There were 14,144 available accessions at the end of 2015 (68% of the total). This maintains the slow incremental increase in availability: 13,876 in 2014 (67%), 13,757 (66.7%) in 2013, 13,753 (66.8%) in 2012 and 13,572 (66.1%) in 2011. Progress would not be possible without in kind regeneration assistance of Monsanto, DuPont Pioneer, 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.

Yearly Accession Availability				
Year	**Total Accessions**	**Available Accessions**	**% Available**	**New Accessions**
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
2015	20,744	14,144	68.2%	53

Viability testing increased again in 2015 to 1,184 (6%) of the collection over the 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. This would require continued increases in testing to over 2,000 accessions.

One hundred and one accessions were backed up at the NLGRP in 2015. Seventy-one accessions were backed up at the NLGRP in 2014. The percent of the collection backed up held at 73%. This percentage changes slowly as regeneration resources are focused on accessions in high demand, many of which are already backed up at the NLGRP.

In future reports we may provide a breakdown in the quality of those backups taking into account quantity, viability, and perhaps in the case of populations, sample size. An example of what is developing in in this area: an analysis of the 307 accessions grown in Ames during 2015 indicate 259 of these have some inventory on hand, but of these 259 samples, only 127 have a backup sample that is considered adequate. Examples of why a backup sample might not be considered adequate include low kernel amount, low viability, quarantine status, voucher status, treated seed, and/or population size. This percentage may also fluctuate considerably as we transfer accessions held only at NLGRP to the active collection.

Distribution:

Orders for all accessions maintained by the maize curator including those of the genera *Tripsacum* and *Coix* decreased 12.4% in 2015 from 2014 compared to a 20% decrease in 2014. Again, it would appear that the implementation of the revised NCRPIS non-research distribution policy put in place in mid-2013 and the incremental recovery of the rate of new PVP expirations after the expiration hiatus is keeping orders nearly stable. 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. Foreign focus continues to increase on inbred line groups as more is published on them, as reflected by requests. A challenge presented to distributing accessions to most of Europe is the USDA APHIS interpretation of the requirement by most European countries of the way that maize seed can be declared free of Stewart's wilt bacteria. Now a field grown accession, observed in the field as not showing Stewart's wilt symptoms, cannot be declared Stewart's wilt free if Stewart's wilt is observed in the state. The NCRPIS pathologist now conducts laboratory ELISA tests on those accessions in order to meet the phytosanitary requirements. This adds to distribution costs and reduces timeliness of distribution.

Annual Distribution Data								
Year	**Total Packets**	**Foreign Packets**	**Total Accs**	**Foreign Accs**	**Orders**	**Foreign Orders**	**Requestors**	**Foreign Requestors**
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
2015	**13,860**	**3,427**	**4,444**	**2,008**	**528**	**87**	**414**	**80**
Averages 2011-15	15,901	3,839	4,106	1,881	690	92	530	82

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 maize 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 2015 packet distribution was reduced by 6.4% and orders were reduced by 33.5%. NR requests were down in 2015 in maize by 11.4% but packet requests were up 31.3%.

Year	Distributed				Cancelled			
	NR Order Packets	NR Order Accs	NR Orders	NR Requestors	NR Order Packets	NR Order Accs	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
2015	0	0	0	0	948	448	263	247

The table below may suggest a way to address the Non-Research requests. It appears that a large percentage of the items requested are for a limited number of accessions. If these accessions could somehow be made available through other non-governmental providers, these requests may diminish. It is this curator's experience that those querying for sunflower, coffee, and strawberries often request the wrong species, i.e. maize accessions named Kansas Sunflower, Strawberry Dent, Copper Strawberry, etc.

Top 25 Most Requested Accessions of the 948 Accessions in Non-Research Requests (34% of total)	
Accession	**Times Requested**
Ames 31675 -- Washonge Corn	41
Ames 22778 -- Blue Fox Flour Corn	27
PI 213796 -- Nueta Sweet Corn	23
PI 255983 -- Pease Crosby Sweet Corn	20
NSL 179257 -- Sweet Corn (Indian)	17
Ames 1850 -- Aunt Mary's Sweet Corn	15
PI 540466 -- Ark. Corn-Borer Composite #3	13
PI 340840 -- R-Strawberry Open Pollinated	12
PI 452064 -- Pinky Popcorn	12
Ames 4171 -- Squaw Corn	11
NSL 26565 -- Blue Indian Corn	11
PI 214292 -- Kansas Sunflower	11
Ames 2758 -- Millersburg Red Sweet No. 2	10
PI 214297 -- Thomas Utility White Corn	10
PI 222648 -- Supergold Popcorn	10
PI 311231 -- Copper Strawberry	10
Ames 26959 -- Sweet Baby Blue	9
Ames 3940 -- Burro Mountain White Popcorn	9
PI 222642 -- Kansas Sunflower	9
PI 377746 -- Baby Sugar Sweet	9
Ames 22642 -- Hooker's Sweet Indian	8
NSL 229320 -- AS11 Sweet Corn Population	7
PI 213763 -- White Thunder	7
PI 414184 -- Strawberry Dent	7
PI 420246 -- Blue Corn	7

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 144 requestors (35% of all *Zea* requestors). Expired PVPs made up some portion of 36% of all Zea orders shipped. Packet distributions of

Expired PVP Annual Distribution Data				
Year	**Total Packets Distributed**	**Total Accessions Distributed**	**Orders Processed**	**Individual Cooperators**
2011	5,137	277	264	158
2012	6,788	303	270	169
2013	6,830	340	269	170
2014	5,125	346	198	149
2015	3,703	372	188	144

these expired PVP inbreds were reduced from previous years because of a lower 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.

Characterization:
There were 11,791 data points loaded into GRIN on 346 accession in 2015. This compares favorably to 2014, 5,099 data points on 332 accessions; 2013, 7,682 on 363 accessions; 2012, 13,212 on 5,196 accessions; and 14,607 data points loaded on 2,807 accessions in 2011.

We imaged 420 accession in 2015 compared to 365, 463, 556, 699, and 520 in 2014, 2013, 2012, 2011 and 2009 respectively. Image loading to GRIN awaits a new process in GRIN-Global.

Evaluation:
Two disease screening nurseries were distributed in 2015. Dr. Bill Dolezal, DuPont Pioneer Hi-Bred, screened 250 accessions for northern leaf blight resistance. Many thanks are extended to DuPont Pioneer Hi-Bred for this long-term, continuing contribution. Dr. Charles Block, USDA-ARS pathologist along with technician Narinder Pal at the NCRPIS, screened 101 accessions for northern leaf blight resistance and provided field inspections for all Ames nurseries.

Plans for 2016:
In 2016 as in recent years, attending to regenerations and regeneration processing will need to take precedence. Regeneration remains my first priority because without viable seed, distribution and resulting research cannot be done. We will be funding at least two tropical increase nurseries of ~500 rows each. Monsanto continues to regenerate tropical accessions on Oahu, Hawaii. DuPont Pioneer continues to regenerate tropical accessions on Puerto Rico.

GRIN-Global was implemented by the NPGS on November 30th, 2015. During 2016 full usage of all the GRIN-Global array of tools will be utilized to enter new and pending data.

The SNP data provided in 2013 from the inbred genotyping/phenotyping project will be heavily used in determining the status of non-PI'ed 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 2016. GRIN-Global should greatly assist in this PI assignment project.

We will assist in additional analyses and publication of the results on the 2,500+ inbred phenotyping/genotyping project.

We will continue acquiring germplasm from public collections. Dr. Walter Trevisan has agreed to go to Hawaii and review with Dr. Brewbaker his inbred line collection for inclusion in NPGS. Dr. Martin Bohn is reviewing the collection put together at Champaign-Urbana by the long retired pathologist Dr. Don White.

I will continue to augment the collection of images currently on GRIN of 5,000 accessions with images of additional accessions in 2016.

A second maize curator will be recruited in 2016 for additional support.

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 2016.

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

Project management:
Curator Dr. Laura Marek is assisted by two full time staff, Irvin Larsen, USDA Research Technician, and Grace Welke, ISU Agronomy Assistant Scientist, and by two part time staff, Lloyd Crim, ISU Farm Equipment Operator, who works for the oilseeds project half days throughout the year, and John Reinhardt, also ISU Farm Equipment Operator, who works full time for the project November through March. The project is also supported by a team of hourly student workers.

Acquisitions:
The oilseed project received 194 new accessions in 2015.

Brassicaceae:
One new *Thlaspi arvense* accession was received from Dr. Terry Isbell, a release of a line he developed with improved germination.

Helianthus:
In 2015, 193 new wild sunflower accessions were received. Fifty three accessions were collected by Dr. Marek as part of two Plant Exchange Office (PEO, USDA-ARS, Beltsville, MD) funded exploration trips in Arizona and Utah (24 accessions, six species) and one PEO funded trip to Florida and Alabama (29 accessions, 10 species). The 2015 wild sunflower plant exploration trips were notable for several reasons. After some years of intense drought, southeastern Utah and northern Arizona received well above their average precipitation by and during summer 2015 with the result that plant populations were amazing and the biggest concern was whether or not back roads would be passable not whether there could be plants. The exploration in Florida was notable because it included travel by boat to five keys, all state parks and/or National Wildlife Refuges. The US Fish and Wildlife Service provided boat, pilot and escort for one location, the University of FL provided transport to another. The remaining three island explorations involved making arrangements to rent licensed commercial operators and their boats. It was challenging coordinating the set schedules that boat trips demanded with field work which is often unpredictable and open ended.

One hundred forty sunflower accessions (five annual species) which filled geographic gaps in the NPGS collection in the southwest were received from Dr. Dylan Burge. An additional six seed samples collected from locations with extant NPGS accessions were added as additional original seed. Dr. Burge's work was part of a comprehensive search for accessions in drought habitats in the southwest directed and funded by Dr. Loren Rieseberg at the University of British Columbia.

Collection Maintenance:
General statistics about availability and management of the collections are presented in Tables 1 and 2 in Appendix Tables 1 and 2. Selected details for oil seed accessions increased during 2015 are noted below.

Helianthus, Ames regenerations:
Cultivated *H. annuus* accessions are 96% available. We are managing regenerations to maintain a high level of availability and to ensure that core collection accessions and other accession groups of specific interest to stakeholders are available. In 2015, 93 cultivated *H. annuus* accessions were regenerated in the field including 99 single-row, 20' plots of 47 accessions in the UGA-SAM1 association mapping population. Of the remaining cultivated accessions, 33 were grown in screened cages with added pollinators and 13 were grown in four-row 20' plots with head bagging and sib pollination. One caged plot was discarded before harvest due to virus infection of the plants. Cultivated *H. annuus* accessions requiring long seasons or short days to flower are increased in the NCRPIS greenhouse as space allows. Two accessions were successfully increased during the winter of 2014-2015.

Seed was harvested from a total of 93 cultivated sunflower plots and processing of the harvest is under way.

Wild annual *Helianthus* accessions are 96% available and wild perennial accessions are 81% available. We attempted 12 wild annual *Helianthus* regenerations (four species). Seeds from one accession did not germinate. The 11 successfully established field populations were all harvested. We attempted 23 new perennial *Helianthus* regenerations; seeds of five accessions did not germinate. Eighteen plots were established in the field and seed was harvested from 17 of the populations as well as from six perennial populations previously established in the field. We generally have difficulty obtaining good seed from *H. tuberosus* accessions due in part to larval infestation of seeds. Based on advice from the USDA sunflower entomologist in Fargo, Dr. Jarrad Prasifka, we re-established *H. tuberosus* populations in a clean field by digging tubers of 21 *H. tuberosus* accessions in fall from NCRPIS south fields, overwintering the tubers wrapped in peat moss in a cool, dry location and re-establishing the populations in one of the far north fields on the farm. The transplanted tubers grew vigorously and seed was harvested from all but one of the plots.

Seed from a total of 11 annual and 44 perennial plots was harvested in 2015; processing of the wild sunflower harvests in underway.

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 procures the honeybee pollinator services), and seed heads are harvested as they mature. Harvested material is shipped to Ames for threshing and processing.

In 2015, 45 accessions were attempted for increase at Parlier. Nine accessions did not germinate; seedlings for 36 accessions were shipped. Seedlings for one accession did not survive shipment and field establishment; heads were harvested from 35 accessions. The 2015 harvested material arrived in Ames in December for processing.

The Parlier staff records basic field data (transplant, flowering and harvest dates and takes some images) but does not have the staff to record standard descriptor data such as ray and disc flower color, plant height, and branching characteristics nor to take all images. Phenotypic information is a valuable component associated with each accession and it is important to capture the observation data. In September 2015, Mr. Larsen, Ms. Welke, 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, and his crew. Curator Dr. Gabriela Romano left the USDA during September 2013 and the search for a new curator continues.

<u>Brassicaceae regenerations</u>:
Brassicaceae accessions are 90% available. The *Brassica* genus encompasses species with a range of growth habits required for successful flowering and seed production. Both *Brassica napus* and *B. rapa* have spring, winter and partial winter types making regenerations of many accessions challenging. In fall 2014, six spring-planted *Brassica napus* accessions that did not flower in the field 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. All six accessions were successfully harvested from seed in 2015. In January 2015 six *B. napus* accessions were started in the greenhouse, vernalized in the NCRPIS cave as seedlings and transplanted to the field. Three of these accessions flowered in the field and were harvested; three did not flower in the field and were transplanted to FGH-2 for overwintering and vernalization as grown plants and harvest in 2016.

In fall 2014, 17 *Brassica* accessions (one *B. rapa* and 16 *B. napus*) were direct seeded in the field to overwinter as young plants and vernalize in the field. Nine of the accessions overwintered and were harvested in spring 2015. In spring 2015, eleven Brassicaceae accessions were direct seeded in the field; five *Camelina* accessions (2 species) did not germinate. The six surviving accessions (three species) were harvested in mid-summer.

In addition, we have been maintaining two perennial *Crambe* accessions in the field since 2012. One, Crambe cordifolia, flowers very profusely but rarely sets seed. The second species, *Crambe maritima*, native to southern England and northern France coastal areas, sets seed some years.

FGH-2 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. Because of the interest in *Thlaspi arvense* as an alternate crop for biofuel production, we have been focused on making all accessions of that species available. *T. arvense* 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. Four *Thlaspi arvense* and one *Mathiola incana* accessions planted in fall 2014 were harvested in late spring 2015. Five *T. arvense* accessions and four *Camelina* accessions (two *C. rumelica* and two *C. laxa*, species which generally do not do well in the field when the summers are hot and humid in Ames) were started in fall 2015 for winter 2015-2016 greenhouse regeneration.

Linum:
Cultivated flax accessions are 99% available. Wild flax accessions are 82% available. Three cultivated flax accessions were successfully regenerated in the 2015 field. Field regeneration of three accessions was not pursued due to low viability scores, and the viability test results were updated in GRIN. Previously, their germination rate was high. One wild flax started for regeneration in 2014 was maintained over the winter in FGH-2 for a 2015 harvest.

Cuphea:
No *Cuphea* regenerations were attempted in 2015. 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 32% available. No miscellaneous aster accessions were attempted in 2015.

Euphorbia:
The *Euphorbia* collection is 44% available. Nine accessions of *Euphorbia lagascae* were regenerated in the field during 2015. *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 availability of the *Euphorbia* collection to more than 50%.

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

Helianthus:
In 2015, 124 orders containing 3766 sunflower items were distributed. Roughly 32% of the items were packets of the 288 line UGA-SAM1 mapping population sent in four complete and seven partial distributions to six researchers at five different universities mapping genetic loci associated with a range of traits including self-

compatibility, heliotrophism, and cold tolerance. The largest individual *Helianthus* orders in 2015 were the SAM distributions. The 2015 distributions included all *Helianthus* taxa in the collection and not unsurprisingly supported a wide range of stated research purposes including abiotic stress tolerance, disease resistance, heliotropism, flowering time, phytoremediation and perennial crop development as well as for unspecified "breeding" use.

<u>Brassicaceae</u>:
In 2015, 110 orders containing 5519 packets of Brassicaceae germplasm were sent out, 46 of which contained only *Brassica* accessions, 28 contained species from other Brassicaceae genera and 36 contained packets of both *Brassica* and other genera in the family and/or other non-Brassicaceae germplasm. 1620 *Brassica* accessions were sent to a researcher initiating a program breeding for oil content and quality in biofuel production and 2355 *Brassica* accessions were sent to nine different scientists working on various aspects of disease resistance. The available *Eruca* collection (235 Brassicaceae accessions) was sent to a breeder in Denmark. The diversity present in the Brassicaceae collection (262 taxa from 21 genera) supports a wide range of research purposes.

<u>*Linum*</u>:
Sixteen scientists requested 81 flax accessions in 2015. The largest order (30 accessions) was sent to a researcher in Massachusetts working to re-establish linen fiber flax in the northeastern United States. Other researchers requested germplasm to characterize the flax genome, to evaluate tolerance to abiotic stress and for disease evaluation.

<u>*Cuphea*</u>:
Five orders containing 34 *Cuphea* accessions were distributed in 2015. Researchers were interested in ornamental development and in the role several *Cuphea* species could play in pollinator conservation efforts within a large vegetable production agricultural matrix.

<u>*Euphorbia*</u>:
Nine scientists requested 17 *Euphorbia* accessions in 2015. Seed was requested for use as reference material and to investigate rubber properties in the latex of one species.

<u>Miscellaneous asters</u>:
Thirteen orders containing 23 miscellaneous aster accessions were distributed in 2015. Distributions were sent to support work in molecular phylogeny in the genus *Tithonia* and in the tribe Vernonieae as well as for reference material and ornamental breeding. One *Tithonia* species was sent to the group investigating pollinator conservation within a large vegetable production agricultural matrix.

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

Helianthus:
Drought Environment Collections: We cooperated with Dr. Loren Rieseberg, University of British Columbia (UBC), to support Dr. Dylan Burge and his collections of wild sunflower seeds from drought habitats in ten states across the southwest. Dr. Burge threshed and cleaned his material at the NCRPIS with support from the oilseed crew. He collected enough seed heads from each location to leave a bulk sample in Ames for accessioning into the NPGS (140 new wild sunflower accessions). Sequencing and SNP analysis of the populations is being carried out at UBC.

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 20 foot single row plots, managed regenerations for a select subset of the population, and assisted in recording observations. In addition, a subset of 10 UGA-SAM1 accessions selected for field performance in response to pollination treatments in 2013 and 2014 was grown in cages under controlled pollination regimes. Data will be presented at the 2016 National Sunflower Association Research Forum, January 2016.

Professional Activities:
Meetings and Presentations:
January: I attended the National Sunflower Association's Annual Research Forum in Fargo, ND and made a presentation to the Sunflower CGC which met the afternoon before the Forum. I traveled from Fargo to San Diego, CA to attend XXII Plant and Animal Genome Conference and, by invitation, a meeting of the Genome Canada group working with sunflower (including the UGA-SAM1 association mapping population).

March: I attended the RF Baker Plant Breeding Symposium, ISU

April: I attended the first formal meeting of the Pennycress Biofuel Working Group (*Thlaspi arvense*, miscellaneous brassicaceae) and presented a brief overview of collection and management techniques for this species at the NCRPIS.

June: Upon invitation, I attended a DARPA *Brassica* biofuel development grant meeting in Moscow, ID. Materials developed under the grant are planned to be deposited and accessioned in the NPGS.

August: I attended the annual NC7 TAC meeting in Ames, IA and made a presentation about the Oilseed Project.

October: I represented the NCRPIS curators at the AAIC meeting in Lubbock, TX and presented a report to the New Crops CGC.

November: I attended the annual Agronomy, Crop and Soil Sciences meeting in Minneapolis, MN. In spring 2015 I was elected vice-chair elect and took over those duties at the fall meeting.

Throughout the year: I completed safety trainings as required, including renewing first aid/CPR certification in December.

Publications:
Prasfika, J.R., Marek, L.F., Lee, D.K., Hahn, V., Bradshaw, J.D. 2015. Effects from early planting of late-maturing sunflowers on damage from primary insect pests in the United States. Helia (submitted)

Kantar, M.B., Sosa, C.C., Khoury, C.K., Castaneda-Alvarez, N.P., Achicanoy, H.A., Bernau, V., Kane, N.C., Marek, L., Seiler, G., Rieseberg, L.H. 2015. Ecogeography and utility to plant breeding of the crop wild relatives of sunflower (*Helianthus annuus* L.). Frontiers in Plant Science. Published 08 October 2015.

Nambeesan, S.U., Mandel, J.R., Bowers, J.E., Marek, L.F., Ebert, D.E., Corbi, J., Rieseberg, L.H., Knapp, S.J., Burke, J.M. 2015. Association mapping in sunflower (*Helianthus annuus* L.) reveals independent control of apical vs. basal branching. BMC Plant Biology. Published 11 March 2015.

Isbell, T.A., Cermak, S.C., Dierig, D.A., Eller, F.J., Marek, L.F. 2015. Registration of Katelyn *Thlaspi arvense* L. (Pennycress) with Improved Non-dormant Traits. Journal of Plant Registrations. Published Jan 9, 2015.

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.

FY 2015 Southern US *Helianthus* collection trip proposal approved and funded $5771.00. Role: PI.

Service Activities:
<u>ISU</u>:
I served as leader for a tour of the station by the Agroforestry Systems class, NREM, ISU.

<u>Journal peer review</u>:
I served as a peer reviewer for submissions to Industrial Crops and Products.

<u>PGOC</u>:
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.

<u>CSSA</u>:
I was elected incoming chair (2017) of the C8 division of the Crop Science Society of America.

Special Mention:
I hosted Nelson Harvey, independent journalist, during a portion of our June collection trip to Utah and Arizona. Mr. Harvey's article "Meet the Scientists Hunting

and Saving Wild Sunflower Seeds" was published in the Fall 2015 issue of Modern Farmer. As part of the publication experience, we hosted Michael Lundgren, Modern Farmer photographer, at the NCRPIS for two days in July. The Modern Farmer article sparked a telephone interview with Chris Bennett, who published "Wild Crop Relatives Invaluable to Agriculture" in the Farm Journal in December, as well as a chat with Bill Giebler and mention of sunflower crop wild relatives in his article, "Seeking Crop Elders", in the Earth Island Journal published in early December.

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 Appendix Table 1: NCRPIS Accessions (Accs), Acquired, Available.

Acquisition:
One *Cucumis melo* and two *Cucurbita pepo* expired PVPs were received, and one *Daucus carota* accession were received from NLGRP (formerly NCGRP) to be incorporated into the NCRPIS collections. One *Daucus carota* accession collected in Skagit County, Washington, by C. E. Christianson (Washington State University), with known resistance to *Xanthomonas hortorum* pv. *carotae*, was donated to the NCRPIS collection.

Maintenance:
Data for vegetable crop regenerations attempted and number of accessions harvested in 2015 are summarized in the appendices in "Table 2: NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up."

Cichorium increases focused primarily on accessions having low or declining seed viabilities based on recent maintenance germination testing results. Fifty-two accessions were planted and harvests were made on 30, three of which produced low seed quantities and will be regenerated again in 2016. Twenty-two accessions failed to germinate from our original seed samples, so subsamples were requested from the backup seed lots stored at the NLGRP in Ft. Collins, CO. These accessions will be regrown in 2016.

Cucumis increases included both greenhouse and field regenerations of seven *C. melo*, 76 *C. sativus*, and six wild *Cucumis* species. Regenerations primarily focused on accessions with low seed quantities or distribution lots 20+ years old. Harvests were made on all but one melon accession which failed to produce fruit. The seed lots will be stored and made available for distribution after viability testing in April 2016.

Cucurbita pepo field regenerations focused on accessions with low seed quantities or distribution lots 20+ years old. Thirteen of 20 accessions were successfully regenerated, three failed to set fruit, and four late flowering/maturing produced only a few fruit. The increase lots will be inventoried and stored after viability testing. This was the first year using the redesigned 15 ft. x 40 ft. x 7 ft. cage frames and screens for the *Cucurbita* field regenerations. The height of the cages was increased from 4.5 feet to 7 feet to better accommodate the plants and allow easier access to the plants by staff and crew. The frames and cage screens were all made on site using materials already on-hand by Cindy Clark (ISU Agricultural Specialist – Vegetables), Jesse Worth (USDA-ARS LA, Contract Employee), and students assigned to the Vegetable Project. In addition to the newly designed *Cucurbita* cage frames and screens, new isolation cages were made for use in our greenhouse regeneration program.

New NCRPIS 15' x 40' x 7' *Cucurbita* cages.

Daucus regeneration efforts focused primarily on Ames-numbered wild, annual species and on old PI-numbered accessions having lower seed quantities. Seventy-three accessions were planted for regeneration and seeds were harvested from 60 accessions. Alternative parent seed lots will be planted in 2016 for the 13 accessions that failed to germinate. 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* 2015 regenerations, we received seed increases of five accessions from Rosa Yzquierdo, Seminis Vegetable Seeds, Idaho and five accessions from Rob Maxwell, Bejo Seeds, Idaho. We also received remnant seed increases of 15 accessions from Paul Heuvelmans, Nunhems (Netherlands). Six cultivated biennial accessions each were sent to Seminis Vegetable Seeds (Idaho) and Bejo Seeds (Oregon), and two wild *Daucus pusillus* accessions were sent to Chris Cramer, University of New Mexico for regeneration in the 2015-2016 growing season.

Pastinaca regenerations focused on 15 accessions with low viability. Harvests were made on eight accessions and seed quantities look good. Seven accessions failed to germinate and were replanted using alternative parent seed lots for regeneration in the 2016 field cages. In 2015, a trellis system was installed inside some *Daucus* and

Pastinaca cages (see photo below) to help “confine” the plants to the center of the cages to prevent flowers from pressing against the screen leading to potential pollen contamination from native insect pollinators outside of the isolation cages. The open perimeter created by this trellis also made seed harvesting easier by allowing better access to plants throughout the cage.

Trellis system inside *Pastinaca* cage.

The Vegetable Project has also been looking for ways to implement the use of biologicals to control insect pests inside greenhouse and field regeneration cages. We have seen improved control of thrips, whiteflies, and aphids with the use of Nemasys Beneficial Nematodes, Encarsia formosa, and lady bugs. We plan to continue to use these biologicals in 2016 and also look for additional/alternative options and applications in our program.

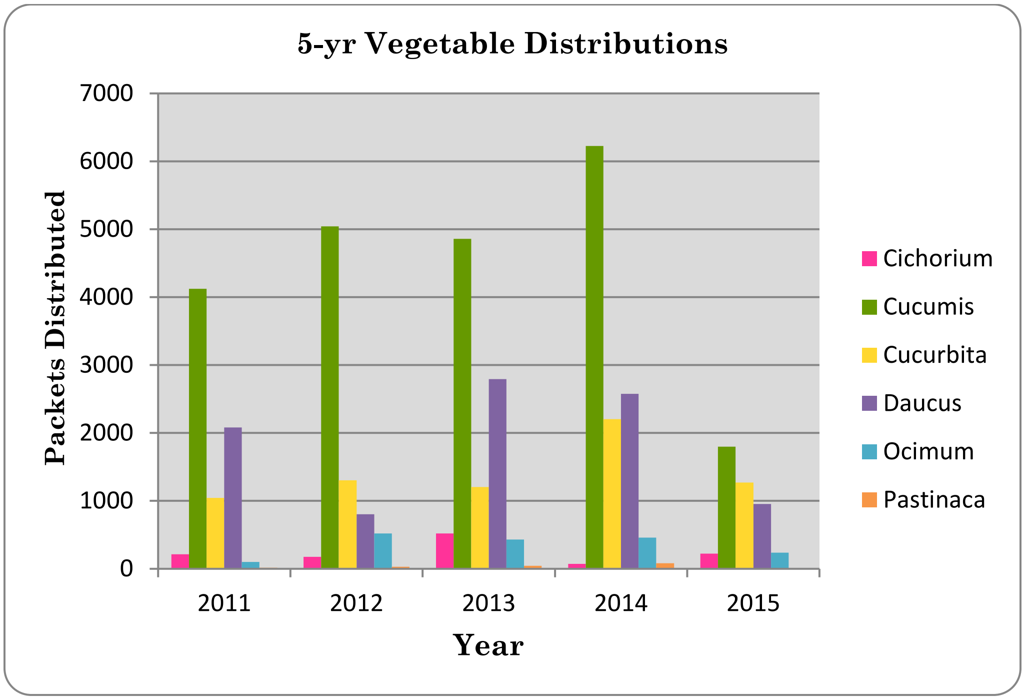
As NCRPIS accessions are regenerated, backup seed samples are sent to NLGRP in Ft. Collins. Overall, 83% of the accessions in the vegetable collections are backed up. Six of eight vegetable site-crops have 80% or more of their accessions backed up at NLGRP (Appendix Table 2). We also sent 56 *Cucumis melo*, 29 *Cucumis sativus*, 11 *Cucurbita pepo*, and 23 *Daucus* (119 accessions total) for backup at the Svalbard Global Seed Vault in 2015. This brings the total number of NCRPIS Vegetable Project accessions backed up at Svalbard to 2355.

In 2015, 777 vegetable accessions were tested for viability (Appendix Table 2), with the majority of the testing attributed to maintenance germinations on distribution lots.

Distribution:

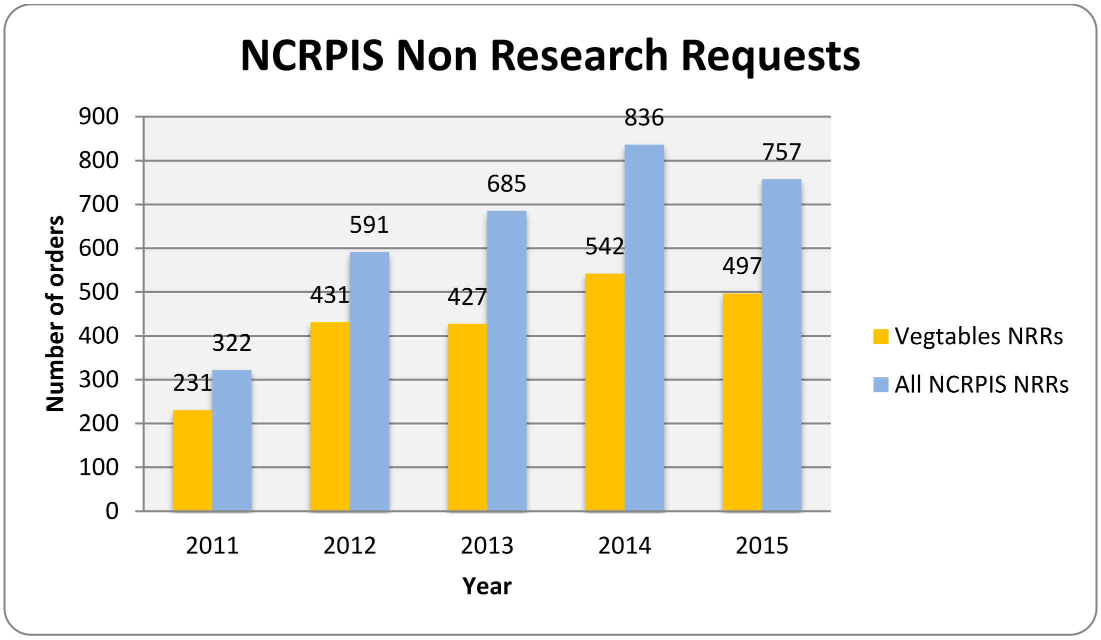
Packet and accession distributions for research and education for the vegetable collections are summarized in the appendices in “Table 3A: External NCRPIS

Distributions”. In 2015, 4498 seed packets (items) involving 2811 accessions were distributed to fulfill 136 orders (90 domestic, 46 foreign) equaling 118 recipients. This year’s distributions are significantly less than distributions in 2014 which included all available *Daucus* (1072 accessions) sent to Pakistan for diversity evaluation; and all or significant portions of the NCRPIS cucurbit collections sent to 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.



Vegetable research requests received in 2015 specified objective 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 2015, 703 orders were received for accessions maintained by the Vegetable Project with 495 of the orders classified as NRR. 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 policy replaced the previous one-time-distribution policy for NRRs. 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 2015 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.

Taxonomic identities are reviewed and confirmed as each accession is regenerated or grown in observation plots. The 2015 reidentifications included seven *Cucumis spp.* re-identified to *C. metuliferus* (4), *C. anguria* var. *longaculeatus* (1), and *C. melo* subsp. *agrestis* (2); one *Daucus muricatus* was reidentified to *D. aureus*, 11 Daucus carota to *D. carota* subsp. *capillifolius*, and four *D. carota* to *D. hybr*. (*Daucus carota* x *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:

Martínez-Flores, F., Arbizu, C.I., Reitsma, K., Juan, A., Simon, P.W., Spooner, D.M., and Crespo, M.B. 2016. Lectotype designation for seven species names in the *Daucus guttatus* complex (*Apiaceae*) from the central and eastern Mediterranean basin. Syst. Bot. In press.

Plans for 2016:

Regenerations:

In October 2015, 31 biennial *Daucus* and 20 *Pastinaca* accessions were planted in the greenhouse for regeneration in field cages during the 2016 summer. In February 2016, 58 *Cichorium* accessions having low viability were also started for regeneration in 2016 summer field cages. An additional 14 annual *Daucus* accessions will be started in the greenhouse in March 2016 for transplanting to 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 2015 cucurbit regeneration seed lots in April 2016 and on the 2015 *Daucus* regeneration seed lots in the summer of 2016.

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
468	Various regeneration images 2015

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.

Over 3106 observation records were loaded to GRIN in 2015 for eight fruit descriptors for the crop group NC7-CUCUMIS. These data were collected during regenerations of *Cucumis sativus* from 1986 through 1991.

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 phenotypic data collected will be loaded into GRIN.

NCRPIS Vegetable Project Collection Stats 2015

Site Crop (Maintenance Policy)	Number Accs	Number Accs Acquired	Number Available	Percent Available	Percent Avail Last Year	PI Numbered Accs	Ames Numbered Accs	NSL Numbered Accs	Backup	Percent Backed up NCGRP	Svalbard
NC7-chicory	279	0	211	79	76	230	23	26	244	87	114
NC7-cucumis.cucs	1388	0	1318	95	95	1230	143	15	1318	95	796
NC7-cucumis.melo	3208	1	2038	64	64	2900	279	25	2590	81	551
NC7-cucumis.wilds	319	0	185	58	58	247	72	0	189	59	48
NC7-cucurbita	976	2	729	75	75	881	90	5	820	84	298
NC7-daucus	1381	1	1093	79	78	965	386	30	1190	86	439
NC7-ocimum	104	0	98	94	88	91	13	0	98	94	76
NC7-parsnips	73	0	50	68	68	52	19	2	50	68	33
Totals	7728	4	5722	74	74	6596	1025	103	6499	84	2355

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 changing 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.

Gardner served in a collaborative group effort to develop ARS' policies and procedures document for sampling for adventitious presence of genetically modified organisms (contamination) in the NPGS collections, and remediation guidelines if contamination is identified.

Gardner was asked to serve on the International Maize Genetic Resources Advisory Committee (IMGRAC) and will travel to CIMMyT in February 2016 for the first meeting of this group.

About 10% of her time 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 continues to progress as several national genebanks and CGIAR genebanks either have gone 'live' or will soon. US Development Team focus was directed to completing USDA security assessments required prior to NPGS implementation on November 30, 2015, a major milestone.

Pete Cyr, our Software Applications and Network Systems Information Specialist, serves as the development lead for the Curator Tool and various wizards and other applications, and the Project's Technical Director. Other Ames personnel include Mark Millard, our maize curator who serves as the Systems Analyst for the project; Lisa Burke, our seed storage manager who serves as a primary beta tester and trainer, and Candice Gardner. NCRPIS development efforts are primarily devoted to this critically important project, and enabling continuity of station information operations. Together with personnel from the ARS GRIN Database Management Unit (DBMU), National Program Leader Peter Bretting, other NPGS site personnel with GRIN or developer 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 were evaluated in yield trials in 2015.

2016 Plans:
With the departure of four key personnel in spring of 2015, we will continue to focus on recruiting and filling 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 were 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.

Publications:
Kurtz, B., Gardner, C.A., Millard, M.J., Nickson, T., and Smith, J.S.C. 2016. Global Access to Maize Germplasm Provided by the US National Plant Germplasm System and by US Plant Breeders. Crop Science 56(3):931-941

Year 2015 Table 1.		NCRPIS Accessions (Accs), Acquired, Available					
01/01/2015 to 12/31/2015							
CURATOR	GENUS_CROP	Number Accs	Number Accs Acquired	Percent Acquired	Number Available	Percent Available	Percent Avail Last Year
Brenner	NC7-amaranth	3336	0	0%	3207	96%	96%
	NC7-celosia	57	0	0%	39	68%	61%
	NC7-echinochloa	305	0	0%	278	91%	92%
	NC7-grasses	132	0	0%	85	64%	64%
	NC7-legumes	250	0	0%	118	47%	47%
	NC7-melilotus	1004	0	0%	835	83%	83%
	NC7-panicum	937	1	0%	906	97%	97%
	NC7-perilla	25	0	0%	18	72%	96%
	NC7-portulaca	10	0	0%	7	70%	70%
	NC7-quinoa	422	60	14%	305	72%	82%
	NC7-setaria	1077	0	0%	1005	93%	93%
	NC7-spinach	413	1	0%	404	98%	98%
	NC7-umbels	1185	0	0%	758	64%	64%
	Total:	**9153**	**62**	**1%**	7965	87%	**88%**
	NC7-medicinals	952	0	0%	684	72%	73%
	NC7-ornamentals	723	1	0%	544	75%	52%
Carstens	NC7-woody.landscape	1865	54	3%	972	52%	51%
	Total:	**3540**	**55**	**2%**	2200	62%	**55%**
Marek	NC7-asters	417	0	0%	134	32%	26%
	NC7-brassica	2008	0	0%	1863	93%	93%
	NC7-brassica.pvp	6	0	0%	0	0%	0%
	NC7-crucifers	1246	1	0%	1094	88%	87%
	NC7-crucifers.pvp	1	0	0%	0	0%	0%
	NC7-cuphea	638	0	0%	510	80%	79%
	NC7-euphorbia	209	0	0%	92	44%	39%
	NC7-flax	2834	0	0%	2815	99%	100%
	NC7-flax.wilds	142	0	0%	117	82%	82%
	NC7-sun.cults	1871	0	0%	1803	96%	96%
	NC7-sun.cults.SAM	288	0	0%	0	0%	100%
	NC7-sun.wilds.ann	1501	39	3%	1417	94%	96%
	NC7-sun.wilds.per	878	14	2%	716	82%	81%
	NC7-sun.wilds.sp	2	0	0%	0	0%	0%
	Total:	**12041**	**54**	**0%**	10561	88%	**90%**
Millard	NC7-corn.kin	101	0	0%	9	9%	11%
	NC7-maize.gems	240	14	6%	219	91%	87%
	NC7-maize.inb	2549	8	0%	2042	80%	79%
	NC7-maize.pop	17117	2	0%	11428	67%	66%
	NC7-maize.pvp	399	29	7%	372	93%	92%
	NC7-maize.wilds	439	0	0%	83	19%	19%
	NC7-zea.totals	20744	53	0%	14144	68%	67%
	Total:	**20845**	**53**	**0%**	14153	68%	**67%**
Reitsma	NC7-chicory	279	0	0%	211	76%	76%
	NC7-cucumis.cucs	1386	0	0%	1321	95%	95%
	NC7-cucumis.melo	3208	1	0%	2038	64%	64%
	NC7-cucumis.wilds	317	0	0%	186	59%	58%
	NC7-cucurbita	976	2	0%	729	75%	75%
	NC7-daucus	1381	2	0%	1092	79%	78%
	NC7-ocimum	104	0	0%	98	94%	88%
	NC7-parsnips	73	0	0%	50	68%	68%
	Total:	**7724**	**5**	**0%**	5725	74%	**74%**
NCRPIS Total:		**53303**	**229**	**0%**	40604	76%	**76%**

Year 2015 Table 2.

01/01/2015 to 12/31/2015

NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up

CURATOR	GENUS_CROP	Number Accs	Number Accs Germed	Percent Accs Germed	Number Attempted Regen	Number Harvested Regen	Number Perm Perennial	Number Perennial Harvested (Vegetative)	Number Accs Growing	Number Accs Made Available	Number Accs Backed Up at NLGRP for YR	Number Accs Backed Up at Svalbard for YR	Number Accs Backed Up at Other Locations for YR	Total Number Accs Backed Up	Percent Accs Backed Up
Brenner	NC7-amaranth	3336	409	12%	209	61	0	0	0	111	95	248	0	3255	98%
	NC7-celosia	57	4	7%	4	3	0	0	0	4	4	0	0	40	70%
	NC7-echinochloa	305	0	0%	3	3	0	0	0	0	0	1	0	275	90%
	NC7-grasses	132	0	0%	3	2	0	0	0	0	0	1	0	90	68%
	NC7-legumes	250	4	2%	1	2	0	0	0	3	0	2	0	179	72%
	NC7-melilotus	1004	33	3%	0	0	0	0	0	0	0	7	0	899	90%
	NC7-panicum	937	7	1%	10	11	0	0	0	3	0	0	0	912	97%
	NC7-perilla	25	14	56%	3	3	0	0	0	3	2	7	0	24	96%
	NC7-portulaca	10	0	0%	1	1	0	0	0	0	0	4	0	8	80%
	NC7-quinoa	422	137	32%	33	22	0	0	0	39	8	118	0	311	74%
	NC7-setaria	1077	6	1%	6	10	0	0	0	0	0	11	0	971	90%
	NC7-spinach	413	1	0%	3	2	0	0	0	0	0	22	0	399	97%
	NC7-umbels	1185	358	30%	50	16	0	0	0	17	9	53	0	766	65%
	Total:	**9153**	**973**	**11%**	**326**	**136**	**0**	**0**	**0**	**180**	**118**	**474**	**0**	**8129**	**89%**
Carstens	NC7-medicinals	952	73	8%	22	31	0	0	0	59	3	29	0	734	77%
	NC7-ornamentals	723	7	1%	1	3	0	0	0	167	3	0	0	556	77%
	NC7-woody.landscape	1865	79	4%	51	98	33	6	1	56	57	2	0	788	42%
	Total:	**3540**	**159**	**4%**	**74**	**132**	**33**	**6**	**1**	**282**	**63**	**31**	**0**	**2078**	**59%**
Marek	NC7-asters	417	2	0%	0	0	0	0	0	27	2	3	0	143	34%
	NC7-brassica	2008	142	7%	7	0	0	0	0	20	4	6	0	1979	99%
	NC7-brassica.pvp	6	0	0%	0	0	0	0	0	0	0	0	0	6	100%
	NC7-crucifers	1246	31	2%	9	4	0	0	2	19	15	1	0	1119	90%
	NC7-crucifers.pvp	1	0	0%	0	0	0	0	0	0	0	0	0	1	100%
	NC7-cuphea	638	0	0%	0	0	0	0	0	0	0	0	0	583	91%
	NC7-euphorbia	209	11	5%	0	1	0	0	0	7	7	0	0	87	42%
	NC7-flax	2834	401	14%	0	0	0	0	0	2	0	0	0	2832	100%
	NC7-flax.wilds	142	0	0%	0	1	0	0	2	1	1	0	0	119	84%
	NC7-sun.cults	1871	246	13%	47	46	0	0	0	40	22	41	0	1810	97%
	NC7-sun.cults.SAM	288	17	6%	290	59	0	0	0	0	0	0	0	0	0%
	NC7-sun.wilds.ann	1641	22	1%	14	0	0	0	0	20	18	43	0	1419	86%
	NC7-sun.wilds.per	878	32	4%	31	1	0	0	0	34	26	112	0	701	80%
	NC7-sun.wilds.sp	2	0	0%	0	0	0	0	0	0	0	0	0	0	0%
	Total:	**12181**	**904**	**7%**	**398**	**112**	**0**	**0**	**4**	**170**	**95**	**206**	**0**	**10799**	**89%**
Millard	NC7-corn.kin	101	5	5%	1	1	0	0	0	0	0	0	0	12	12%
	NC7-maize.gems	240	20	8%	37	44	0	0	0	33	1	0	0	71	30%
	NC7-maize.inb	2549	172	7%	231	191	0	0	0	113	12	0	0	1576	62%
	NC7-maize.pop	17117	878	5%	244	285	0	0	0	286	80	0	0	13135	77%
	NC7-maize.pvp	399	38	10%	43	43	0	0	0	52	8	0	0	399	100%
	NC7-maize.wilds	439	0	0%	0	0	0	0	0	0	0	0	0	44	10%
	NC7-zea.totals	*20744*	*1108*	*5%*	*555*	*563*	*0*	*0*	*0*	*484*	*101*	*0*	*0*	*15225*	*73%*
	Total:	**20845**	**1113**	**5%**	**556**	**564**	**0**	**0**	**0**	**484**	**101**	**0**	**0**	**15237**	**73%**
Reitsma	NC7-chicory	279	35	13%	52	30	0	0	0	0	0	0	0	244	87%
	NC7-cucumis.cucs	1386	28	2%	77	76	0	0	0	27	24	29	0	1318	95%
	NC7-cucumis.melo	3208	58	2%	6	6	0	0	0	7	5	56	0	2590	81%
	NC7-cucumis.wilds	317	60	19%	15	8	0	0	0	1	1	0	0	187	59%
	NC7-cucurbita	976	234	24%	20	20	0	0	0	6	3	11	0	819	84%
	NC7-daucus	1381	377	27%	81	68	0	0	0	16	15	23	0	1190	86%
	NC7-ocimum	104	6	6%	2	0	0	0	0	6	6	0	0	98	94%
	NC7-parsnips	73	0	0%	20	8	0	0	0	0	0	0	0	50	68%
	Total:	**7724**	**798**	**10%**	**273**	**216**	**0**	**0**	**0**	**63**	**54**	**119**	**0**	**6496**	**84%**
NCRPIS Total:		**53443**	**3947**	**7%**	**1627**	**1160**	**33**	**6**	**5**	**1179**	**431**	**830**	**0**	**42739**	**80%**

Year 2015 Table 3.

01/01/2015 to 12/31/2015

External NCRPIS Distributions - Includes both DI (research and education), RP (Repatriation), OB (Observation), and NR (home garden) order types

			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients
Brenner	NC7-amaranth	3336	450	370	40	31	701	551	19	18	1151	789	59	49
	NC7-celosia	57	33	23	9	9	7	6	5	5	40	25	14	14
	NC7-echinochloa	305	38	26	15	14	39	33	3	3	77	53	18	17
	NC7-grasses	132	9	6	7	7	1	1	1	1	10	7	8	8
	NC7-legumes	250	74	72	5	5	0	0	0	0	74	72	5	5
	NC7-melilotus	1004	5	3	4	4	20	20	3	3	25	23	7	7
	NC7-panicum	937	15	15	7	6	231	217	5	5	246	224	12	11
	NC7-perilla	25	15	9	7	6	23	23	1	1	38	25	8	7
	NC7-portulaca	10	13	6	8	8	1	1	1	1	14	6	9	9
	NC7-quinoa	422	1042	251	53	49	1241	205	34	33	2283	286	87	82
	NC7-setaria	1077	183	128	33	31	141	135	9	9	324	252	42	40
	NC7-spinach	413	1246	405	17	13	35	34	4	4	1281	405	21	17
	NC7-umbels	1185	323	267	28	23	189	183	9	8	512	323	37	31
	Total:	**9153**	**3446**	**1581**	**170**	**140**	**2629**	**1409**	**75**	**72**	**6075**	**2490**	**245**	**212**
Carstens	NC7-medicinals	952	306	240	35	33	36	36	6	6	342	259	41	39
	NC7-ornamentals	723	133	120	17	17	14	14	5	5	147	128	22	22
	NC7-woody.landscape	1865	370	178	90	70	22	22	7	7	392	192	97	77
	Total:	**3540**	**809**	**538**	**127**	**105**	**72**	**72**	**15**	**14**	**881**	**579**	**142**	**119**
Marek	NC7-asters	417	17	17	11	11	1	1	1	1	18	17	12	12
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-brassica	2008	2978	1974	49	43	1900	1419	19	19	4878	1975	68	62
	NC7-crucifers	1246	602	219	44	41	441	413	13	13	1043	498	57	54
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	638	33	32	4	4	0	0	0	0	33	32	4	4
	NC7-euphorbia	209	13	10	7	7	2	2	2	2	15	10	9	9
	NC7-flax	2834	65	57	14	14	0	0	0	0	65	57	14	14
	NC7-flax.wilds	142	1	1	1	1	2	2	1	1	3	3	2	2
	NC7-sun.csr	2	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.cults	1871	359	260	50	37	559	420	29	28	918	542	79	65
	NC7-sun.cults.SAM	288	925	288	11	6	288	288	1	1	1213	288	12	7
	NC7-sun.wilds.ann	1501	264	236	30	23	75	69	8	8	339	296	38	31
	NC7-sun.wilds.per	878	267	190	26	25	72	67	3	2	339	232	29	27
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	**12043**	**5524**	**3284**	**195**	**154**	**3340**	**2681**	**61**	**59**	**8864**	**3950**	**256**	**213**
Millard	NC7-corn.kin	101	19	9	7	7	0	0	0	0	19	9	7	7
	NC7-maize.gems	240	630	228	20	18	353	230	6	6	983	230	26	24
	NC7-maize.inb	2549	4598	1933	230	192	1543	1113	53	48	6141	1973	283	240
	NC7-maize.pop	17117	2556	1629	168	136	334	316	26	24	2890	1807	194	160
	NC7-maize.pvp	399	2524	372	155	115	1179	335	33	29	3703	372	188	144
	NC7-maize.wilds	439	106	48	31	29	18	14	8	8	124	53	39	37
	NC7-zea.totals	*20744*	*10414*	*4210*	*434*	*328*	*3427*	*2008*	*87*	*80*	*13841*	*4435*	*521*	*408*
	Total:	**20845**	**10433**	**4219**	**441**	**334**	**3427**	**2008**	**87**	**80**	**13860**	**4444**	**528**	**414**
Reitsma	NC7-chicory	279	46	42	6	6	166	119	4	4	212	140	10	10
	NC7-cucumis.cucs	1386	259	214	20	20	378	322	18	17	637	448	38	37
	NC7-cucumis.melo	3208	562	445	30	26	438	388	15	14	1000	744	45	40
	NC7-cucumis.wilds	317	10	10	4	4	114	77	6	5	124	82	10	9
	NC7-cucurbita	976	823	658	30	27	449	399	6	6	1272	696	36	33
	NC7-daucus	1381	724	581	23	18	291	149	5	5	1015	601	28	23
	NC7-ocimum	104	72	54	10	10	167	98	4	4	239	98	14	14
	NC7-parsnips	73	8	7	2	2	1	1	1	1	9	7	3	3
	Total:	**7724**	**2504**	**2011**	**94**	**75**	**2004**	**1553**	**46**	**44**	**4508**	**2816**	**140**	**119**
NCRPIS Total:		**53305**	**22716**	**11633**	**921**	**695**	**11472**	**7723**	**265**	**250**	**34188**	**14279**	**1186**	**945**

Year 2015 Table 4.

01/01/2015 to 12/31/2015

NCRPIS Accessions (Accs) Observations (Obs) in GRIN, Images in GRIN

CURATOR	GENUS_CROP	Number Accs in Collection	Number of Accs Obs Trials	Number of Obs in GRIN for Year	Number of Accs with Obs in GRIN for Year	Number of Obs In GRIN Last Year	Number of Accs with Obs In GRIN Last Year	Number of Obs in GRIN (all years)	Number of Acc with Obs in GRIN (all years)	Number of Accs Imaged	Number of Accs with Images in GRIN for Year	Number of Images in GRIN for Year	Number Acc Images in GRIN (all years)	Number of Images in GRIN (all years)
Brenner	NC7-amaranth	3336	121	10391	3335	2893	328	48033	3335	0	0	0	743	1166
	NC7-celosia	57	1	0	0	0	0	164	56	0	0	0	16	39
	NC7-echinochloa	305	1	0	0	763	305	1157	305	0	0	0	63	129
	NC7-grasses	132	0	1	1	258	113	281	113	0	0	0	21	23
	NC7-legumes	250	0	0	0	0	0	547	244	0	0	0	29	41
	NC7-melilotus	1004	0	0	0	3086	995	7235	996	0	0	0	190	244
	NC7-panicum	937	0	0	0	2468	936	3371	936	1	0	0	126	241
	NC7-perilla	25	0	0	0	0	0	86	25	0	0	0	10	17
	NC7-portulaca	10	0	0	0	0	0	10	4	0	0	0	2	6
	NC7-quinoa	422	6	0	0	56	49	1191	355	60	0	0	149	203
	NC7-setaria	1077	0	1	1	3161	1073	4045	1073	0	0	0	156	309
	NC7-spinach	413	2	12	3	2325	401	8008	401	2	0	0	17	49
	NC7-umbels	1185	0	0	0	285	11	6265	1148	2	0	0	201	354
	Total:	**9153**	**131**	**10405**	**3340**	**15295**	**4211**	**80393**	**8991**	**65**	**0**	**0**	**1723**	**2821**
Carstens	NC7-medicinals	952	122	0	0	0	0	11956	447	7	0	0	414	815
	NC7-ornamentals	723	68	0	0	0	0	152	101	1	0	0	101	153
	NC7-woody.landscape	1865	47	508	62	999	86	3971	801	40	0	0	726	1550
	Total:	**3540**	**237**	**508**	**62**	**999**	**86**	**16079**	**1349**	**48**	**0**	**0**	**1241**	**2518**
Marek	NC7-asters	417	0	0	0	0	0	8	1	3	0	0	0	0
	NC7-brassica	2008	295	921	921	22696	1625	36713	1965	0	0	0	332	922
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-crucifers	1246	49	6347	821	0	0	6351	821	25	0	0	329	798
	NC7-crucifers.pvp	1	0	10	1	0	0	10	1	0	0	0	0	0
	NC7-cuphea	638	0	0	0	0	0	4260	278	0	0	0	13	34
	NC7-euphorbia	209	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-flax	2834	0	0	0	0	0	1717	285	0	0	0	1	1
	NC7-flax.wilds	142	0	0	0	0	0	852	82	0	0	0	2	2
	NC7-sun.cults	1871	7	1387	46	777	43	104239	1824	0	0	0	251	655
	NC7-sun.cults.SAM	288	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1641	0	245	24	186	14	40118	1307	2	0	0	64	120
	NC7-sun.wilds.per	878	3	430	39	405	35	13850	630	0	0	0	124	329
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	**12181**	**354**	**9340**	**1852**	**24064**	**1717**	**208118**	**7194**	**30**	**0**	**0**	**1116**	**2861**
Millard	NC7-corn.kin	101	1	0	0	0	0	0	0	1	0	0	7	7
	NC7-maize.gems	240	49	1204	51	1036	53	5664	209	54	0	0	103	412
	NC7-maize.inb	2549	253	6250	2019	1494	108	75797	2431	157	0	0	587	1107
	NC7-maize.pop	17117	0	3278	164	1608	85	165696	13214	165	0	0	4199	6470
	NC7-maize.pvp	399	43	1059	219	961	61	13018	399	43	0	0	219	618
	NC7-maize.wilds	439	0	0	0	0	0	331	200	0	0	0	107	115
	NC7-zea.totals	*20744*	*345*	*11791*	*2453*	*5099*	*307*	*260506*	*16453*	*419*	*0*	*0*	*5215*	*8722*
	Total:	**20845**	**346**	**11791**	**2453**	**5099**	**307**	**260506**	**16453**	**420**	**0**	**0**	**5222**	**8729**
Reitsma	NC7-chicory	279	0	0	0	0	0	4700	279	0	0	0	257	913
	NC7-cucumis.cucs	1386	0	3059	323	0	0	26149	1377	76	0	0	920	1231
	NC7-cucumis.melo	3208	0	35	5	0	0	12285	3195	7	0	0	649	1074
	NC7-cucumis.wilds	317	0	15	3	0	0	681	287	6	0	0	75	110
	NC7-cucurbita	976	6	0	0	2	2	5695	970	20	0	0	150	326
	NC7-daucus	1381	60	0	0	3258	158	19384	1360	57	0	0	680	3139
	NC7-ocimum	104	0	0	0	0	0	635	98	0	0	0	13	17
	NC7-parsnips	73	0	0	0	0	0	153	71	8	0	0	1	1
	Total:	**7724**	**66**	**3109**	**331**	**3260**	**160**	**69682**	**7637**	**174**	**0**	**0**	**2745**	**6811**
NCRPIS Total:		**53443**	**1134**	**35153**	**8038**	**48717**	**6481**	**634778**	**41624**	**737**	**0**	**0**	**12047**	**23740**

Year 2015 Table 5.

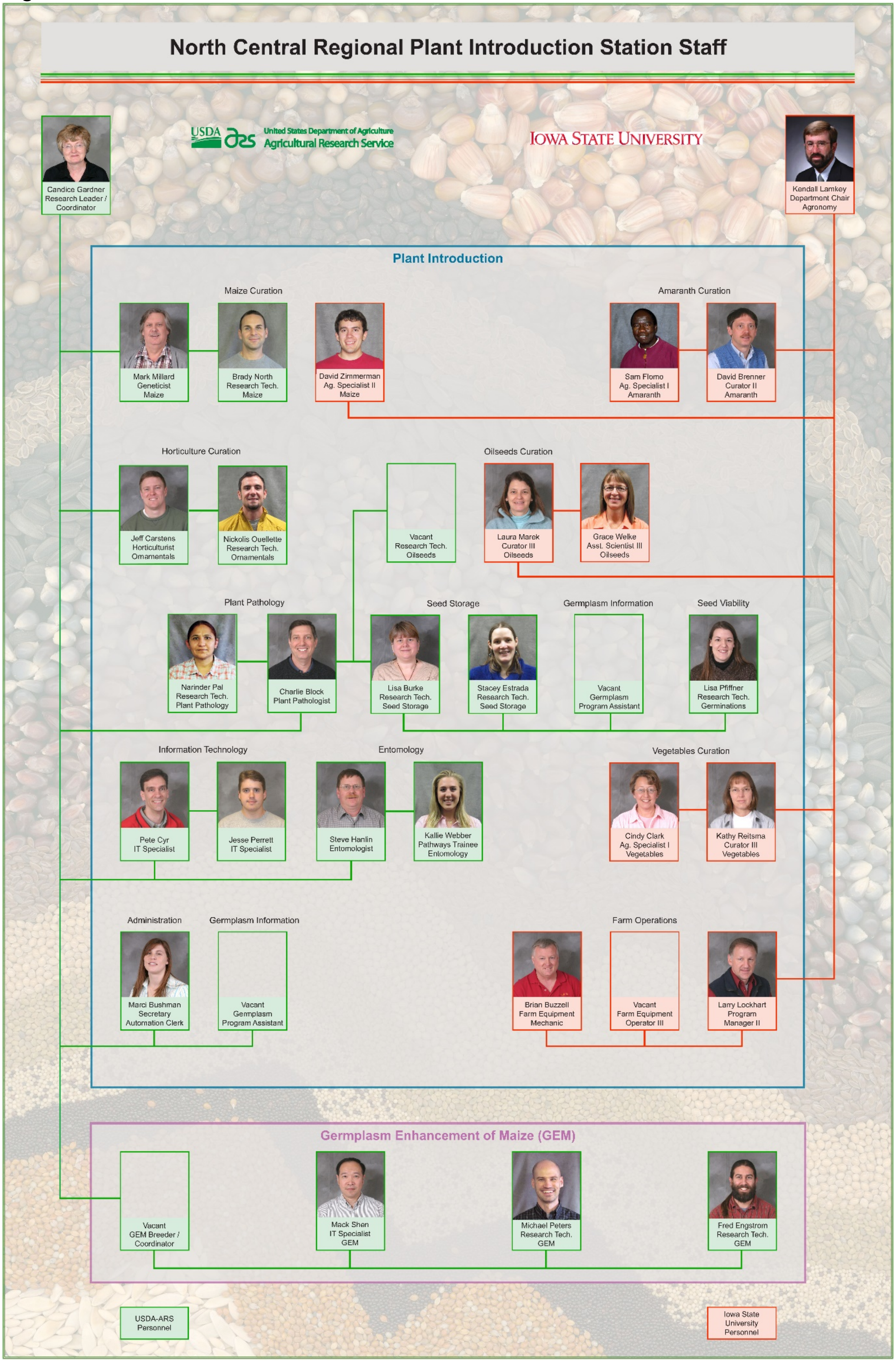
01/01/2015 to 12/31/2015

NCRPIS Accessions (Accs) Health Testing and Records in GRIN

CURATOR	GENUS_CROP	Number Accs in Collection	Number of Items Shipped for Path Testing	Number of Accs Shipped for Path Testing	GRIN Accs Observed for Pathogens in Year	GRIN Pathogen Observations in Year	All GRIN Accs Observed for Pathogens	All GRIN Lots Observed for Pathogens	All GRIN Pathogen Observations	All GRIN Accs Positive for Pathogens	All GRIN Lots Positive for Pathogens	All GRIN Positive Pathogen Observations
Brenner	NC7-amaranth	3336	0	0	0	0	0	0	0	0	0	0
	NC7-celosia	57	0	0	0	0	0	0	0	0	0	0
	NC7-echinochloa	305	0	0	0	0	0	0	0	0	0	0
	NC7-grasses	132	0	0	0	0	0	0	0	0	0	0
	NC7-legumes	250	0	0	0	0	0	0	0	0	0	0
	NC7-melilotus	1004	0	0	0	0	0	0	0	0	0	0
	NC7-panicum	937	0	0	0	0	17	17	34	0	0	0
	NC7-perilla	25	0	0	0	0	0	0	0	0	0	0
	NC7-portulaca	10	0	0	0	0	0	0	0	0	0	0
	NC7-quinoa	422	0	0	0	0	0	0	0	0	0	0
	NC7-setaria	1077	0	0	0	0	133	134	287	0	0	0
	NC7-spinach	413	0	0	0	0	0	0	0	0	0	0
	NC7-umbels	1185	0	0	0	0	0	0	0	0	0	0
	Total:	**9153**	**0**	**0**	**0**	**0**	**150**	**151**	**321**	**0**	**0**	**0**
Carstens	NC7-medicinals	952	0	0	0	0	91	122	122	0	0	0
	NC7-ornamentals	723	0	0	0	0	0	0	0	0	0	0
	NC7-woody.landscape	1865	0	0	0	0	0	0	0	0	0	0
	Total:	**3540**	**0**	**0**	**0**	**0**	**91**	**122**	**122**	**0**	**0**	**0**
Marek	NC7-asters	417	0	0	0	0	0	0	0	0	0	0
	NC7-brassica	2008	0	0	0	0	0	0	0	0	0	0
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0
	NC7-crucifers	1246	0	0	0	0	0	0	0	0	0	0
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	638	0	0	0	0	0	0	0	0	0	0
	NC7-euphorbia	209	0	0	0	0	0	0	0	0	0	0
	NC7-flax	2834	0	0	0	0	0	0	0	0	0	0
	NC7-flax.wilds	142	0	0	0	0	0	0	0	0	0	0
	NC7-sun.cults	1871	35	35	80	190	490	550	1339	0	0	0
	NC7-sun.cults.SAM	288	0	0	0	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1641	0	0	0	0	64	66	147	0	0	0
	NC7-sun.wilds.per	878	0	0	0	0	123	243	403	0	0	0
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0
	Total:	**12181**	**35**	**35**	**80**	**190**	**677**	**859**	**1889**	**0**	**0**	**0**
Millard	NC7-corn.kin	101	0	0	0	0	5	7	25	0	0	0
	NC7-maize.gems	240	27	27	28	43	173	252	1070	73	83	92
	NC7-maize.inb	2549	621	605	710	2450	2320	4431	20733	776	1166	1229
	NC7-maize.pop	17117	185	179	221	662	4191	5254	26760	969	1110	1294
	NC7-maize.pvp	399	340	331	358	787	399	757	5380	72	80	87
	NC7-maize.wilds	439	4	4	4	4	114	139	342	8	8	9
	NC7-zea.totals	*20744*	*1177*	*1146*	*1321*	*3946*	*7197*	*10833*	*54285*	*1898*	*2447*	*2711*
	Total:	**20845**	**1177**	**1146**	**1321**	**3946**	**7202**	**10840**	**54310**	**1898**	**2447**	**2711**
Reitsma	NC7-chicory	279	0	0	0	0	0	0	0	0	0	0
	NC7-cucumis.cucs	1386	0	0	75	77	715	822	4139	574	634	924
	NC7-cucumis.melo	3208	0	0	6	8	2532	3509	12554	1868	2454	4121
	NC7-cucumis.wilds	317	0	0	0	0	55	64	379	2	2	2
	NC7-cucurbita	976	0	0	20	25	52	60	207	16	16	16
	NC7-daucus	1381	0	0	0	0	1	1	2	0	0	0
	NC7-ocimum	104	0	0	0	0	0	0	0	0	0	0
	NC7-parsnips	73	0	0	0	0	0	0	0	0	0	0
	Total:	**7724**	**0**	**0**	**101**	**110**	**3355**	**4456**	**17281**	**2460**	**3106**	**5063**
NCRPIS Total:		**53443**	**1212**	**1181**	**1502**	**4246**	**11475**	**16428**	**73923**	**4358**	**5553**	**7774**

Year 2015 Table 6.			Cancelled External NCRPIS Items - NR (home gardner) order types											
01/01/2015 to 12/31/2015			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients
Brenner	NC7-amaranth	3336	135	105	52	46	0	0	0	0	135	105	52	46
	NC7-celosia	57	16	11	11	11	0	0	0	0	16	11	11	11
	NC7-echinochloa	305	3	2	3	3	0	0	0	0	3	2	3	3
	NC7-grasses	132	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-legumes	250	4	2	4	4	0	0	0	0	4	2	4	4
	NC7-melilotus	1004	63	38	33	31	1	1	1	1	64	39	34	32
	NC7-panicum	937	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-perilla	25	16	9	6	6	0	0	0	0	16	9	6	6
	NC7-portulaca	10	7	3	5	5	0	0	0	0	7	3	5	5
	NC7-quinoa	422	62	34	42	38	1	1	1	1	63	35	43	39
	NC7-setaria	1077	25	12	19	17	0	0	0	0	25	12	19	17
	NC7-spinach	413	158	52	84	79	0	0	0	0	158	52	84	79
	NC7-umbels	1185	474	214	150	136	11	11	2	2	485	218	152	138
	Total:	**9153**	**963**	**482**	**275**	**247**	**13**	**13**	**2**	**2**	**976**	**488**	**277**	**249**
Carstens	NC7-medicinals	952	408	177	150	140	2	2	1	1	410	177	151	141
	NC7-ornamentals	723	158	88	52	48	0	0	0	0	158	88	52	48
	NC7-woody.landscape	1865	177	134	72	66	1	1	1	1	178	134	73	67
	Total:	**3540**	**743**	**399**	**213**	**192**	**3**	**3**	**2**	**2**	**746**	**399**	**215**	**194**
Marek	NC7-asters	417	22	17	17	16	0	0	0	0	22	17	17	16
	NC7-brassica.pvp	6	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-brassica	2008	186	144	55	48	0	0	0	0	186	144	55	48
	NC7-crucifers	1246	100	75	49	44	5	5	1	1	105	76	50	45
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	638	34	31	10	9	0	0	0	0	34	31	10	9
	NC7-euphorbia	209	5	4	4	3	0	0	0	0	5	4	4	3
	NC7-flax	2834	62	43	26	23	0	0	0	0	62	43	26	23
	NC7-flax.wilds	142	10	5	8	8	0	0	0	0	10	5	8	8
	NC7-sun.csr	2	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.cults	1871	253	162	88	81	28	28	2	1	281	182	90	82
	NC7-sun.cults.SAM	288	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1641	67	24	57	53	0	0	0	0	67	24	57	53
	NC7-sun.wilds.per	878	111	55	51	49	1	1	1	1	112	55	52	50
	NC7-sun.wilds.sp	2	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	**12183**	**850**	**560**	**228**	**201**	**34**	**34**	**4**	**3**	**884**	**581**	**232**	**204**
Millard	NC7-corn.kin	101	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-maize.gems	240	5	5	3	3	0	0	0	0	5	5	3	3
	NC7-maize.inb	2549	71	55	31	29	1	1	1	1	72	56	32	30
	NC7-maize.pop	17117	848	368	243	229	3	3	2	2	851	371	245	231
	NC7-maize.pvp	399	11	7	8	8	0	0	0	0	11	7	8	8
	NC7-maize.wilds	439	6	6	2	2	3	3	1	1	9	9	3	3
	NC7-zea.totals	*20744*	*941*	*441*	*259*	*243*	*7*	*7*	*4*	*4*	*948*	*448*	*263*	*247*
	Total:	**20845**	**941**	**441**	**259**	**243**	**7**	**7**	**4**	**4**	**948**	**448**	**263**	**247**
Reitsma	NC7-chicory	279	42	30	19	17	1	1	1	1	43	30	20	18
	NC7-cucumis.cucs	1386	419	115	191	181	5	5	3	3	424	115	194	184
	NC7-cucumis.melo	3208	300	121	154	143	2	2	2	2	302	122	156	145
	NC7-cucumis.wilds	317	36	20	25	25	0	0	0	0	36	20	25	25
	NC7-cucurbita	976	504	109	210	201	3	3	3	3	507	109	213	204
	NC7-daucus	1381	384	118	164	161	0	0	0	0	384	118	164	161
	NC7-ocimum	104	306	77	109	106	4	4	2	2	310	77	111	108
	NC7-parsnips	73	18	10	12	12	0	0	0	0	18	10	12	12
	Total:	**7724**	**2009**	**600**	**485**	**443**	**15**	**15**	**7**	**7**	**2024**	**601**	**492**	**450**
NCRPIS Total:		**53445**	**5506**	**2482**	**739**	**653**	**72**	**72**	**13**	**12**	**5578**	**2517**	**752**	**665**

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
Brady North Research Tech. Maize
David Zimmerman Ag. Specialist II Maize
Amaranth Curation
Sam Flomo Ag. Specialist I Amaranth
David Brenner Curator II Amaranth
Horticulture Curation
Jeff Carstens Horticulturist Ornamentals
Nickolis Ouellette Research Tech. Ornamentals
Oilseeds Curation
Vacant Research Tech. Oilseeds
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
Stacey Estrada Research Tech. Seed Storage
Germplasm Information
Vacant Germplasm Program Assistant
Seed Viability
Lisa Pfiffner Research Tech. Germinations
Information Technology
Pete Cyr IT Specialist
Jesse Perrett IT Specialist
Entomology
Steve Hanlin Entomologist
Kallie Webber Pathways Trainee Entomology
Vegetables Curation
Cindy Clark Ag. Specialist I Vegetables
Kathy Reitsma Curator III Vegetables
Administration
Marci Bushman Secretary Automation Clerk
Germplasm Information
Vacant Germplasm Program Assistant
Farm Operations
Brian Buzzell Farm Equipment Mechanic
Vacant Farm Equipment Operator III
Larry Lockhart Program Manager II
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