PLANT INTRODUCTION STATIONS UPDATE

Melanie Harrison, USDA-ARS
National Plant Germplasm Coordinating Committee
Annual Meeting – June 9, 2022

NCRPIS

- North Central Regional NC-007 Project

- Plant Introduction Research Unit

Ames, IA

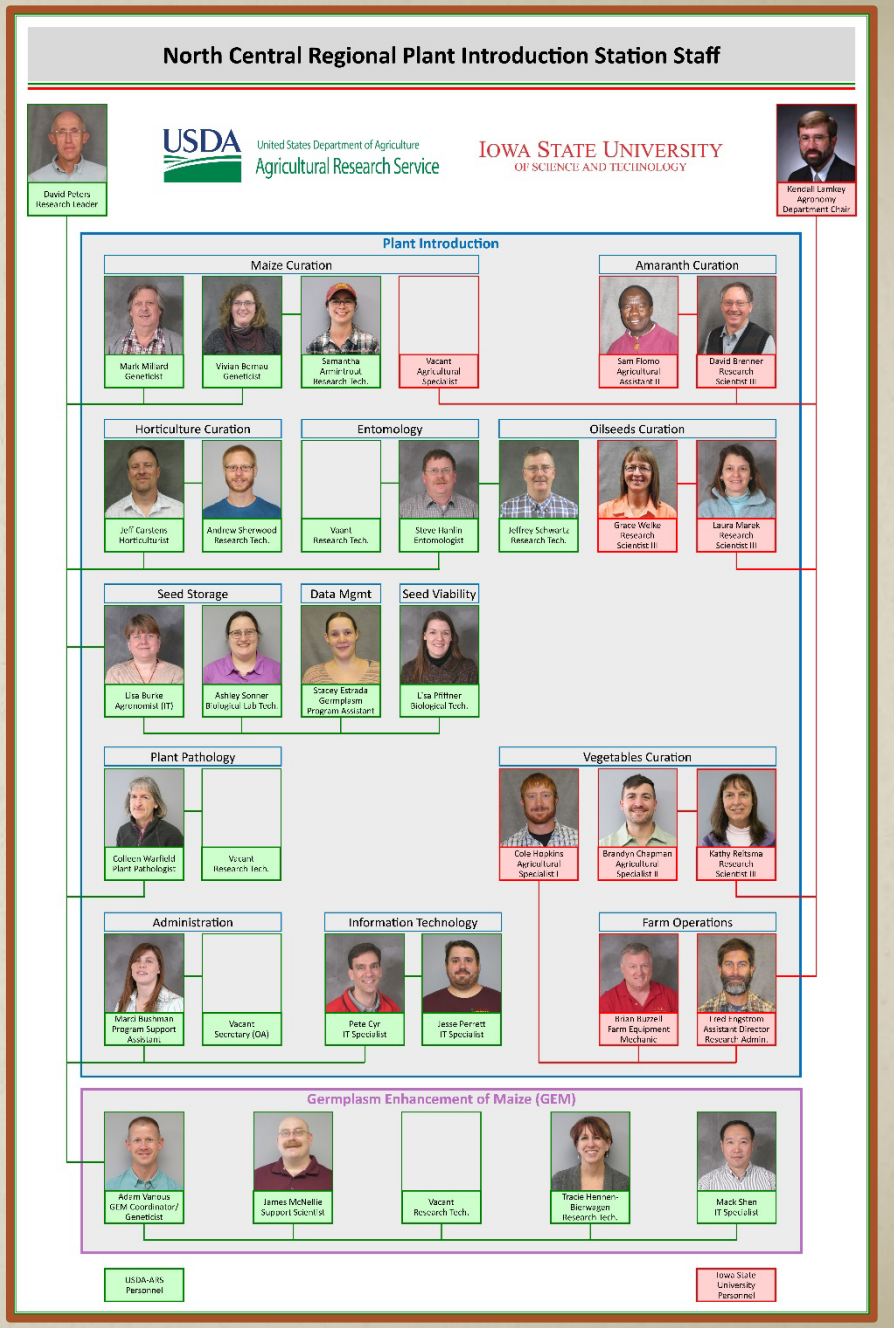
PIRU Organization & Staffing

❖ Plant Introduction Group

- 29 Total Full-time Staff (19 ARS, 10 NC-007)
- Curation Staff - 14
- Plant Pathology & Pollinator Management - 4
- Germplasm Storage, Distribution & Viability Testing - 4
- IT/GRIN-Global Programing & Support - 2
- Site Management and Support - 5

❖ Germplasm Enhancement of Maize (GEM) Project

- 5 ARS Staff
- Maize genetic diversity pre-breeding program
- Public/Private Partnership
- 60+ Cooperators (Public & Private, Domestic & International)
- Released lines added to NPGS Maize collection



Amaranth, Millet, Miscellaneous Umbels

Curator: David Brenner

- Spinach collection requests remained strong
- 33 Accessions added to collection
- Regeneration kept on track
  - 235 Accessions regenerated
  - Collaborative amaranthus regeneration in North Carolina
  - Collaborative spinach regeneration in California
- Wild *Chenopodium* dormancy breaking protocol developed, improving viability testing and regeneration

GENUS_CROP	Acquired	% Available	Total Accessions
Grass.echinochloa	0	90	315
Grass.misc	0	59	142
Grass.panicum	0	97	936
Grass.setaria	1	94	1,117
Subtotal Grasses:	**1**	**93**	**2,510**
Legume.melilotus	0	86	1,006
Legume.misc	7	53	311
Subtotal Legumes:	**7**	**79**	**1,317**
Pseudocereal.amaranth	14	97	3,353
Pseudocereal.celosia	1	64	61
Pseudocereal.perilla	0	96	25
Pseudocereal.portulaca	0	77	13
Pseudocereal.quinoa	9	61	663
Subtotal Pseudocereals:	**24**	**90**	**4,115**
Spinach	1	76	414
Umbels	0	69	1,196
Brenner Total:	**33**	**86**	**9,552**
NCRPIS Total:	**248**	**80**	**54,391**

Sunflowers & Oilseed Brassicas

Curator: Laura Marek

- Sunflower collection requests remain strong
- 15 Accessions add to collection
- 251 Accessions regenerated
  - 50 Flax
  - 80 Brassica
  - 121 Sunflower
  - Regeneration at Ames reduced 30% in 2021 (Covid restrictions & labor shortage)
  - Collaborative regenerations continued with Parlier, CA
- Brassica collection viability showing weakness. Increases in regeneration needed
- Focus increasing on *Linum* regeneration to maintain availability

GENUS_CROP	Acquired	% Available	Total Accessions
Asters	2	34	459
Brassica	0	91	2,019
Crucifers	0	87	1,307
Cuphea	0	80	638
Euphorbia	0	47	210
Flax	5	99	2,839
Flax.Wilds	0	77	167
Sunflower.Cultivars	1	93	2,647
Sunflower.Wild (Ann & Per)	7	92	2,610
Marek Total:	**15**	**90**	**12,896**
NCRPIS Total	**248**	**80**	**54,391**

Vegetable Crops (Cucurbits & Daucus)

Curator: Kathy Reitsma

- Germplasm requests remain strong
- 23 Accessions added to collection
- 115 Accessions regenerated
  - 25 Chicory
  - 30 *Cucumis*
  - 40 *Daucus*
  - 21 *Ocimum*
  - Regeneration scaled back 40% (Pandemic & labor shortage [full-time & seasonal staffing])
  - Collaborative *Daucus* regenerations with private industry

GENUS_CROP	Acquired	% Available	Total Accessions
Chicory	0	89	285
Cucumis.cucumber	0	95	1,401
Cucumis.melo	22	59	3,250
Cucumis.wilds	0	69	218
Cucurbita	1	73	981
Daucus	0	82	1,563
Ocimum	0	94	106
Parsnips	0	79	73
Reitsma Total:	**23**	**74**	**7,977**
NCRPIS Total:	**248**	**80**	**54,391**

Maize

Curators: Vivian Bernau & Mark Millard

- Germplasm demand remains strong
- 123 Accessions added to collection
- 277 Accessions regenerated
  - 30 Public inbreds
  - 78 Ex-PVP
  - 165 Populations (Tropical & Highland)
  - 3 Teosinte
- Wild relative regeneration remains a challenge
- Tropical populations regeneration will be major challenge
  - Viability is dropping
  - Tropical site options limited

GENUS_CROP	Acquired	% Available	Total Accessions
Maize.GEM Lines	7	99	401
Maize.Public Inbreds	26	80	2,697
Maize.Populations	8	78	15,797
Maize.Ex-PVP	80	100	603
Maize.Wild Relatives	2	20	478
Bernau & Millard Total:	**123**	**78**	**19,976**
NCRPIS Total:	**248**	**80**	**54,391**

Woody Landscape, Ornamentals, & Medicinal

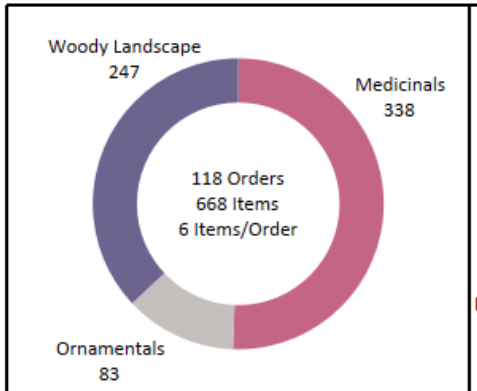
Curator: Jeff Carstens

- Germplasm collection travel limited (Pandemic)
- 54 Accessions added to collection
- 75 Accessions regenerated
  - 21 Medicinal
  - 5 Ornamentals
  - 49 Woody landscape
- Field activities limited (Pandemic & labor shortage)

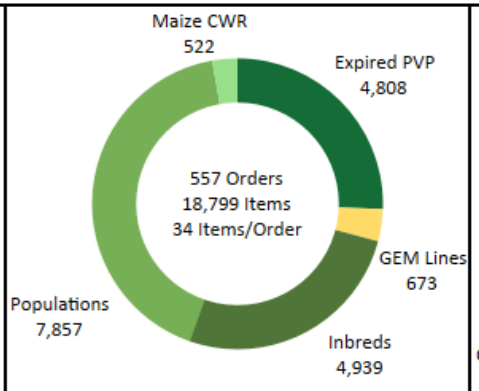
GENUS_CROP	Acquired	% Available	Total Accessions
Medicinals	18	71	1,133
Ornamentals	3	71	778
Woody.landscape	33	54	2,079
Carstens Total:	**54**	**62**	**3,990**
NCRPIS Total:	**248**	**80**	**54,391**

2021 NCRPIS Germplasm Distribution

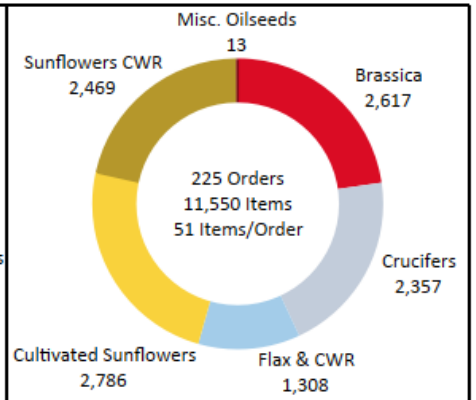
2021 - Crop Distributed Order Items by NCRPIS Curatorial Group



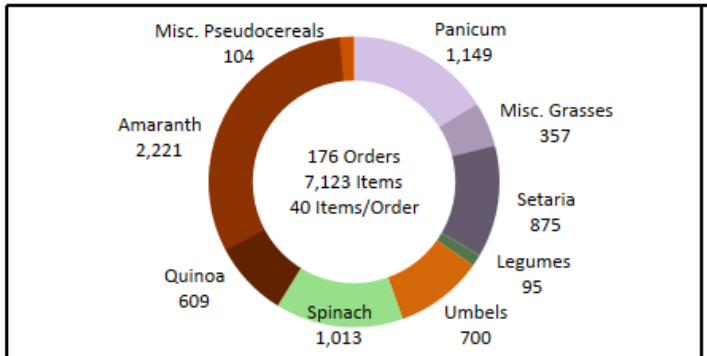
Horticulture



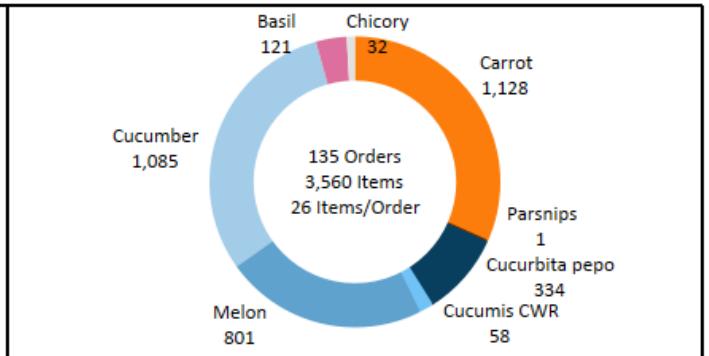
Maize



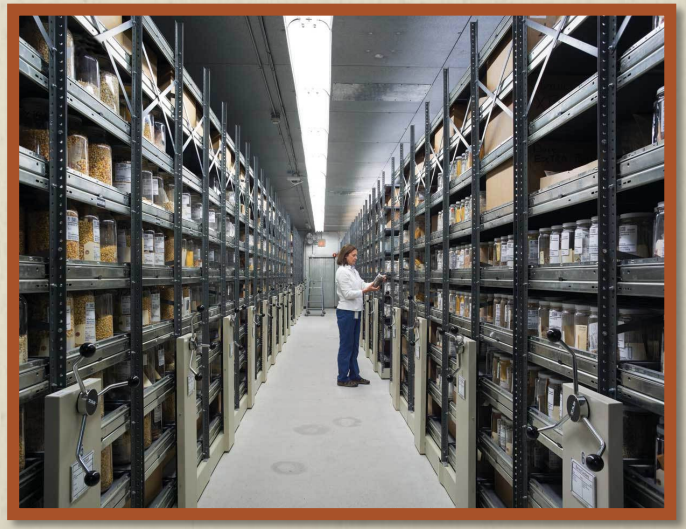
Oilseeds



Pseudocereals



Vegetables



USDA-ARS Plant Genetic Resources Unit

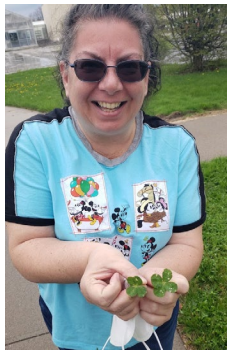
Northeast Regional PI Station (NE9)

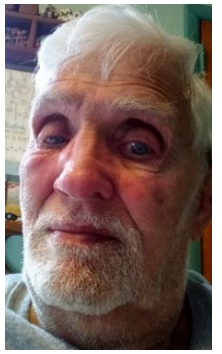


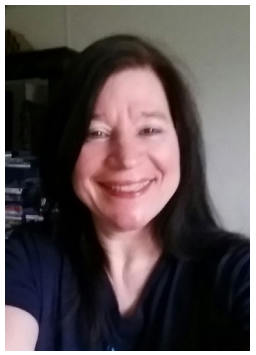









Clonal:

- Ben Gutierrez, apple & tart cherry
- Erin Galarneau, grape
    - Erin joined in July 2021

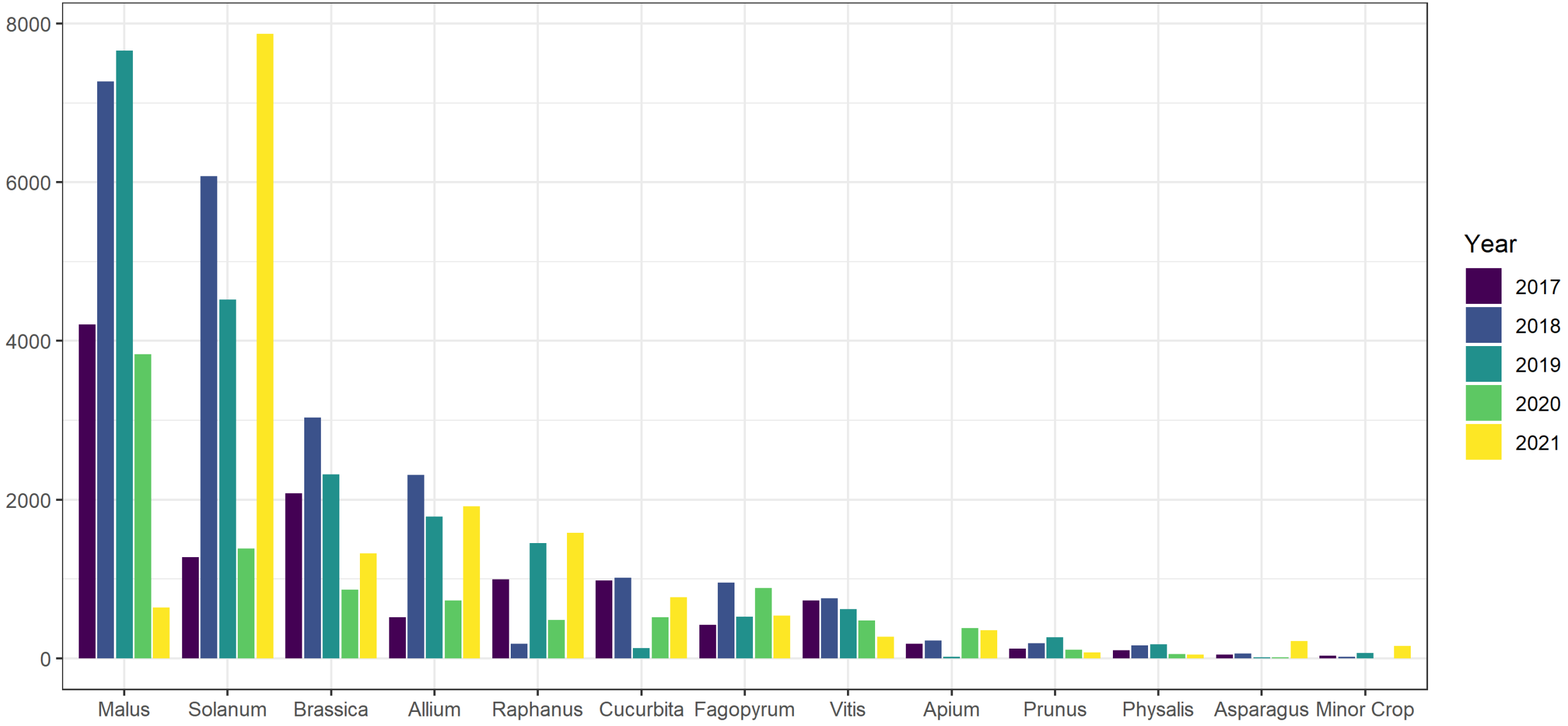
Vegetable: Zachary Stansell

- tomato
- onion
- radish
- winter squash
- brassica
- other vegetables

Hemp: Zachary Stansell & Tyler Gordon

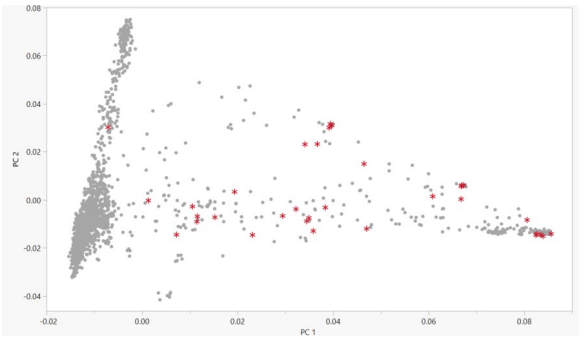
- Tyler joined in May 2022

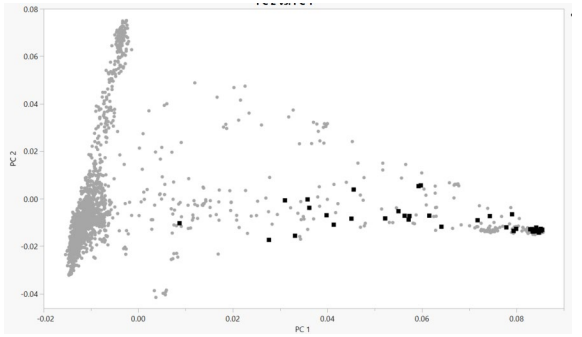
Distribution of NE9 Geneva Germplasm



Apple Documentation and Evaluation

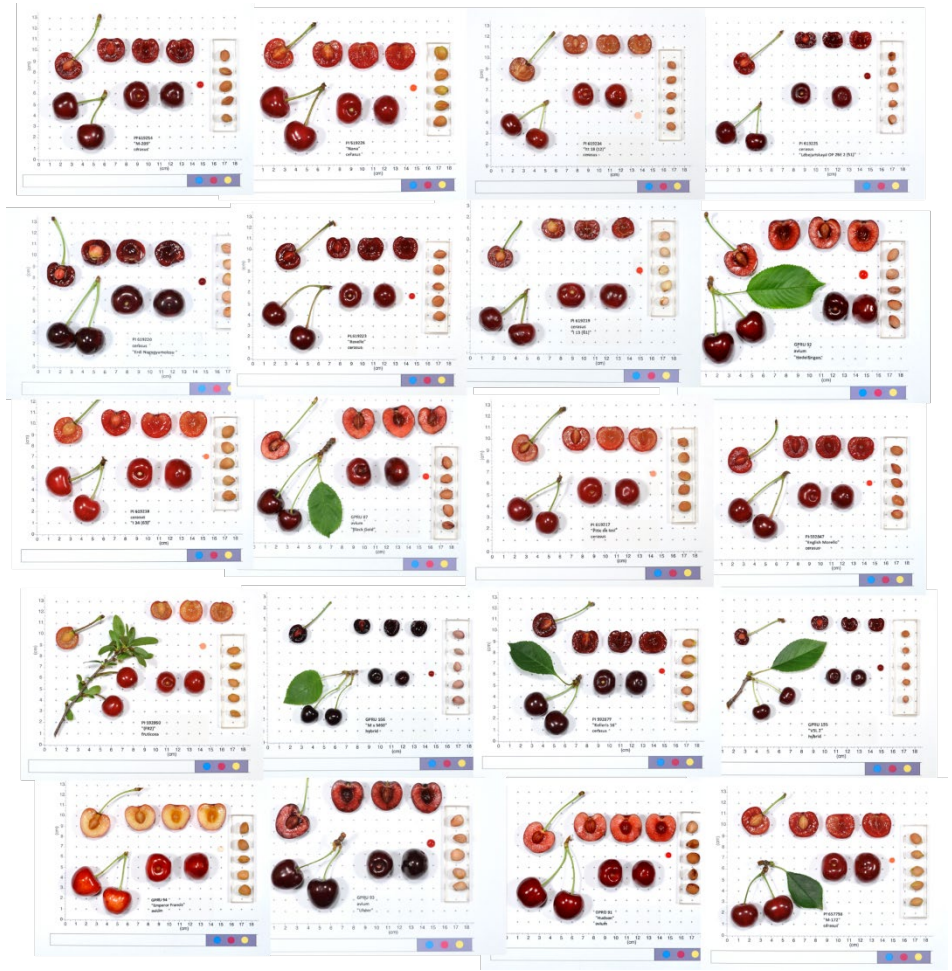
Imaged 367 accessions of wild and hybrid *Malus* accessions to validate classification.



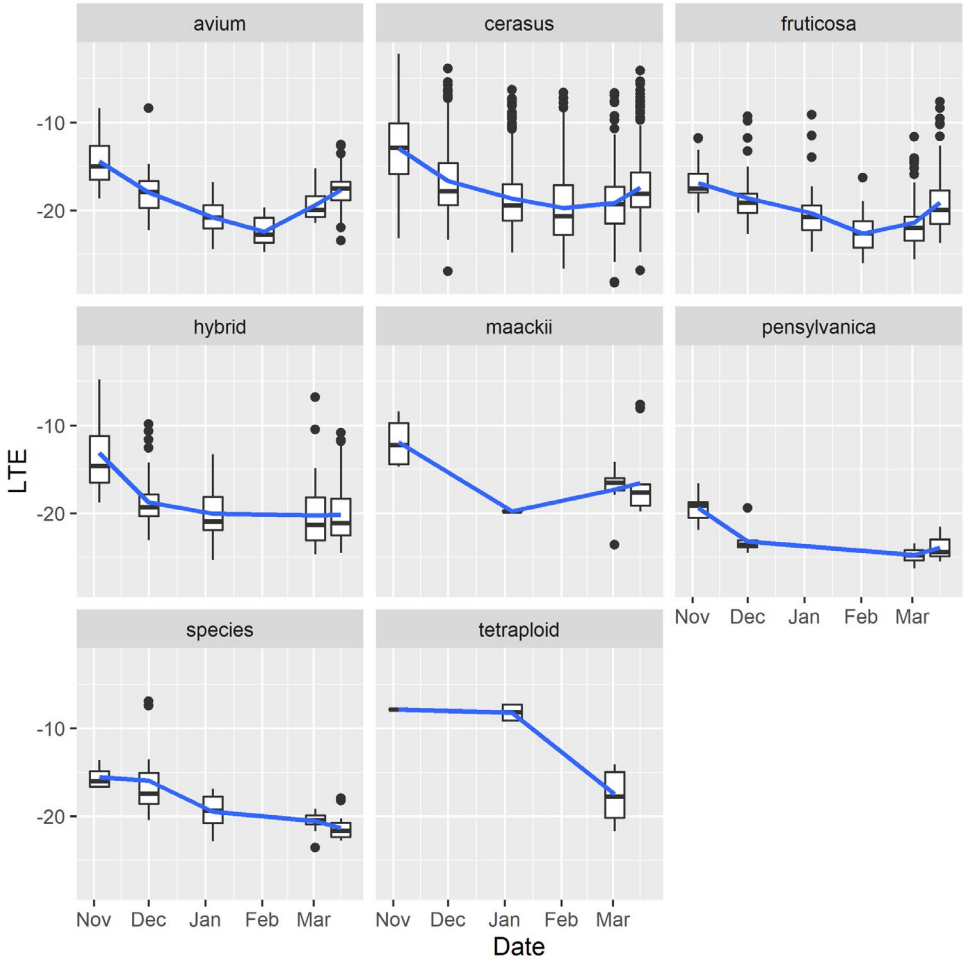


Documenting classification errors in *Malus* : Morphological and genetic variation across accessions assigned as *M. prunifolia* (top, red) and *M. baccata* (bottom, black), with genetic relationships shown in PCA plots.

Tart Cherry Evaluation and Documentation



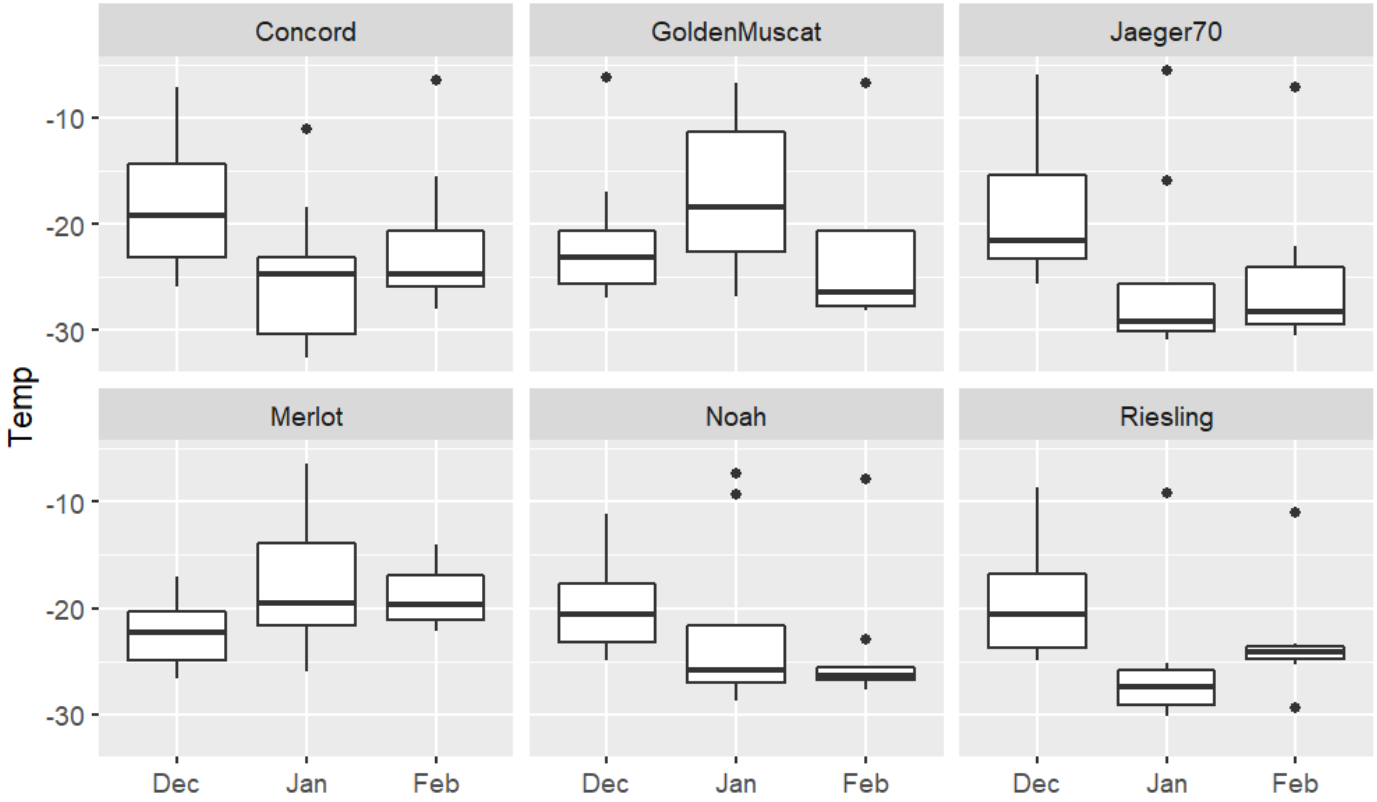
Fruit images uploaded to GRIN for 50+ accessions to fill documentation gaps.



Low Temperature Exotherm (LTE) assays determine cold hardy acclimation and deacclimation in *Prunus* germplasm. This adaptability sets the limits for crop production in cold climates.

Cold Hardy *Vitis* Evaluation and Documentation

Low Temperature Exotherm (LTE) assays started to determine the cold hardy acclimation in *Vitis* germplasm.



195 regenerations underway in 2021-2022 and 1 reintroduction in 2021.

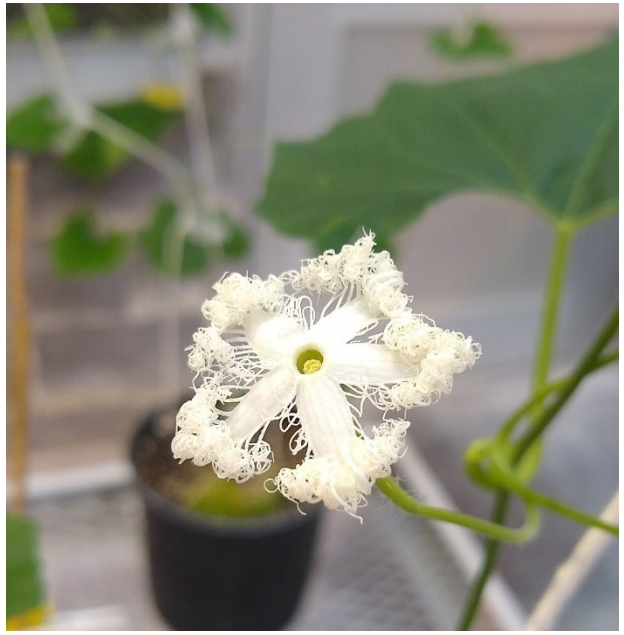
Evaluation and update of current inventory.

- Began assessing fungal and viral pathogen resistances for the full collection.
- Leading update to Grape Crop Vulnerability statement.

Vegetable Germplasm Collections

Germplasm regeneration, collection, and outreach highlights:

- Successful regeneration of 783 accessions from 2017 – 2021 (~157/y), 276 regenerations underway in 2022.
- Deep evaluation of current inventories, activating accessions, prioritizing rescue materials, optimizing throughput of seed testing.
- In 2022, PGRU is rescuing >100 jeopardized accessions.
- NE9 is planting cabbage and squash to donate to the foodbank FoodLink NY.



We are rescuing several critical PGRU germplasm collections including the *Tricosanthes* (snake gourd) collection c/o Marlie Lukach

Hemp germplasm repository:

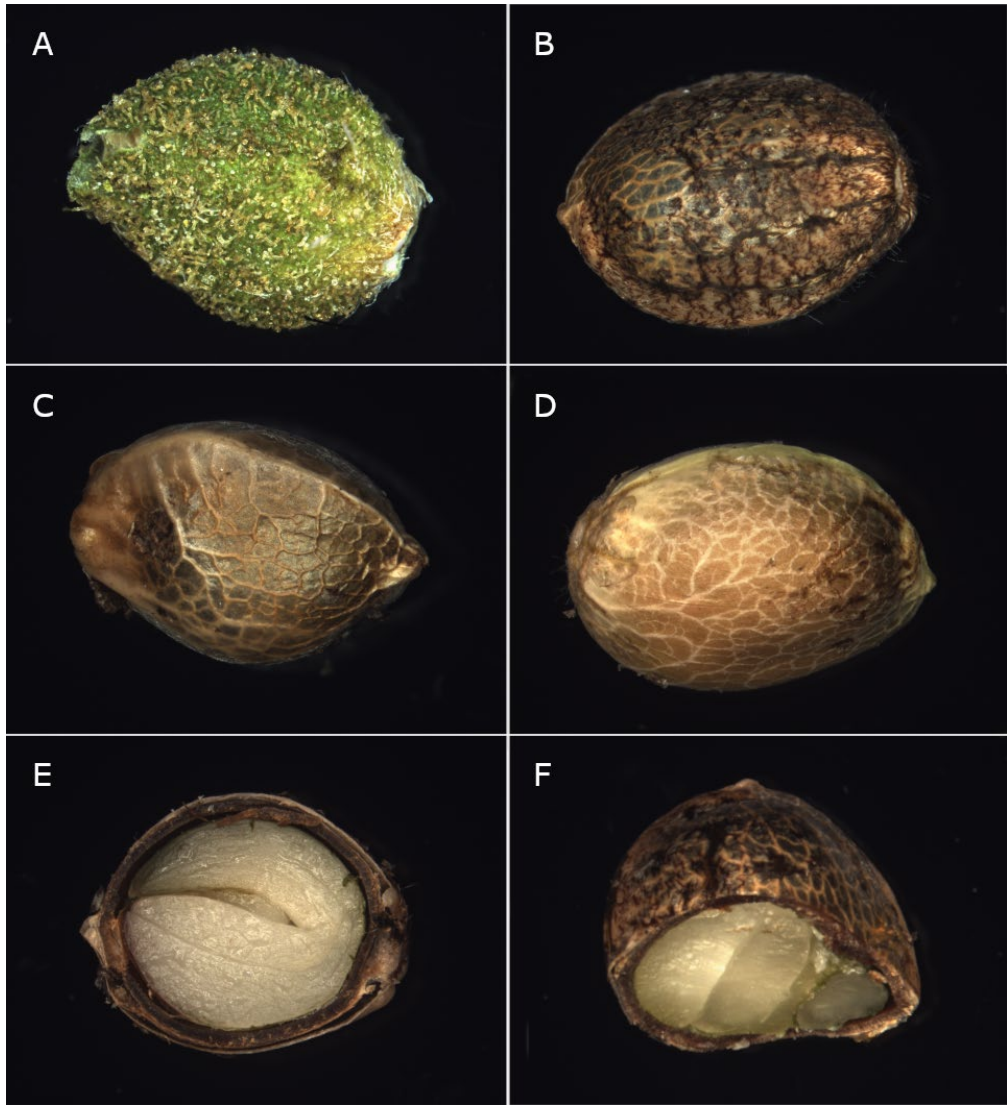
Germplasm Review (completed) → **Established BMPs** (completed) → **Hired Breeder and Curator** (complete) → **Established Collaborator Network** (complete) → **DEA Licensing** (Complete) → **Infrastructure Projects** (Ongoing) → **Germplasm acquisition, increase, evaluation, distribution, breeding** (Ongoing)

Hemp germplasm repository online:

- Hired Cat 1 Breeder (Tyler Gordon)
- 219 hemp accessions. NE9 is now the second largest public hemp germplasm collection, on track to be the largest by EOY.
- New infrastructure and partnerships applied to high-throughput screening of hemp collection for priority agronomic, oil, fiber, and secondary metabolites.
- CGC approval of *Hemp Germplasm Descriptors Handbook.*

Ongoing Challenges:

- Rapidly scaling seed increase and production to meet high demands.
- Developing common genotyping platform
- Identifying core collection



Digitization of historic records

Habit- Vine

Name Cucurbita maxima P.I. No 143274

Origin Iran Date Rec'd 6/15/54 G No. 1292 B

Rec'd as _____ or. sd; _____ inc. sd. _____ plts. CV. Name _____

Year evaluated '55; '63; '82

Notes '55 118g. - SS(Feb.'56) GSS (712-19) 88% germ.
(712-20) 11/25/70
91% germ.

Seed received from B.F. Dana, Path., O.S.C., Corvallis,

Oregon. Also received from Cheyenne 6/15/54, or. ex '82

OP = 48gm. 3/29/66

S= 160gm. 3/29/66

(2) GSS'63 (1452 gms) 76% germ 2-85

(over)

Early passport and correspondence for PI 143274. C/o Nancy Consolie

Southern Regional
S-009 Project

Plant Genetic Resources
Conservation Unit

Griffin, GA

Grif16399






16 USDA, ARS Employees
8 University of Georgia (S-009) Employees















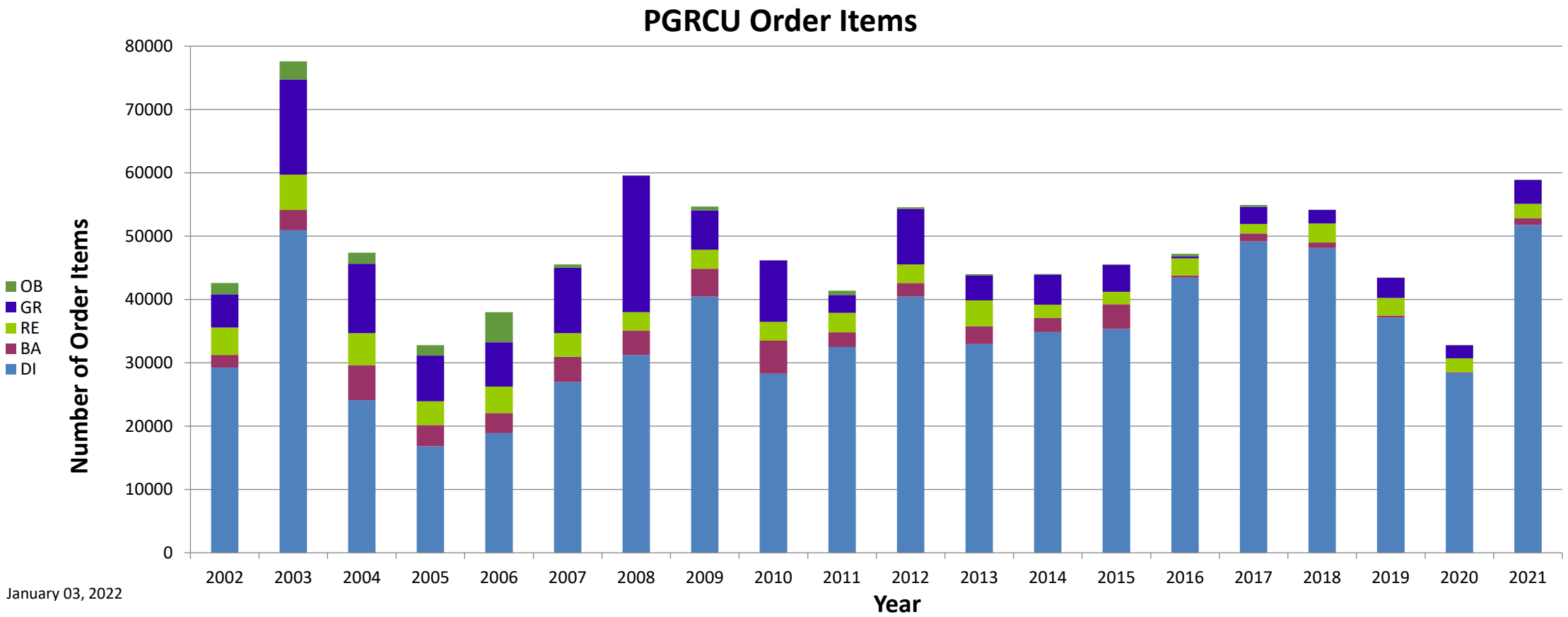


- The PGRCU collection totals 102,611 accessions of 1601 species and 286 genera with 87% available for distribution and 95% backed up at Ft. Collins, CO.

- A total of 51,773 accessions were distributed in worldwide in 2021. Of these, 7156 accessions were distributed to researchers in the S-009 Region. Sorghum and cowpeas were the most requested crop.

- Currently, 88,119 accessions or 87% of the seeded accessions in the collection are stored at -18°C. Seed longevity is improved by storage in -18°C rather than 4°C.

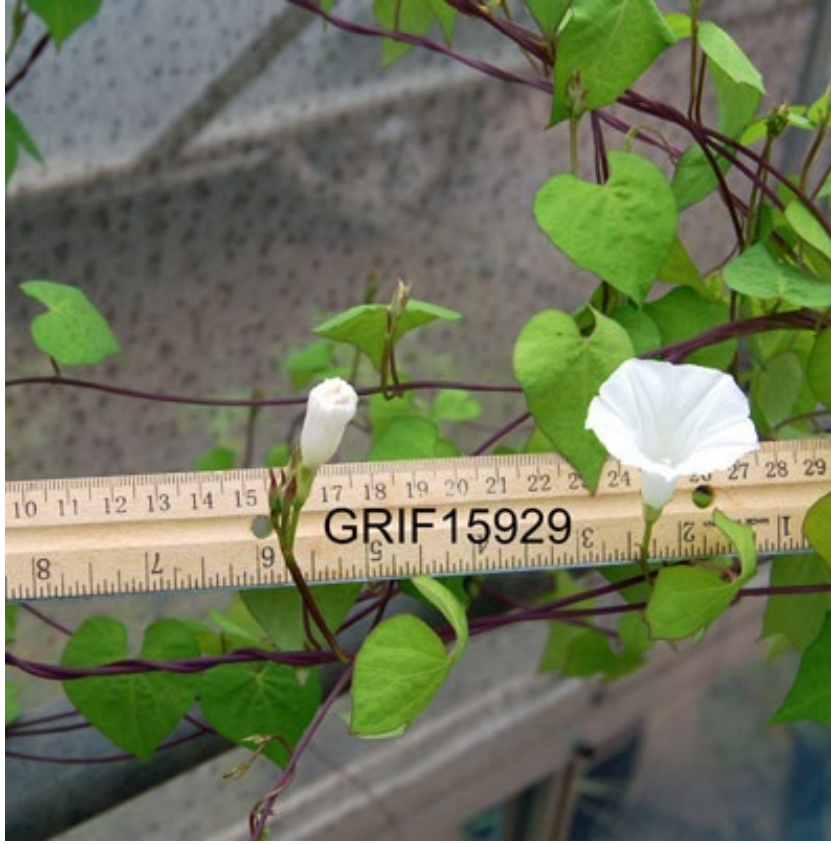
OB = Observation; GR = Germination; RE = Regeneration; BA = Back Up; DI = Distribution



January 03, 2022

Regenerations

- Griffin, GA
- Byron, GA
- Immokalee, FL
- Parlier, CA
- St. Croix, Virgin Islands
- Pearce, AZ
- Netherlands

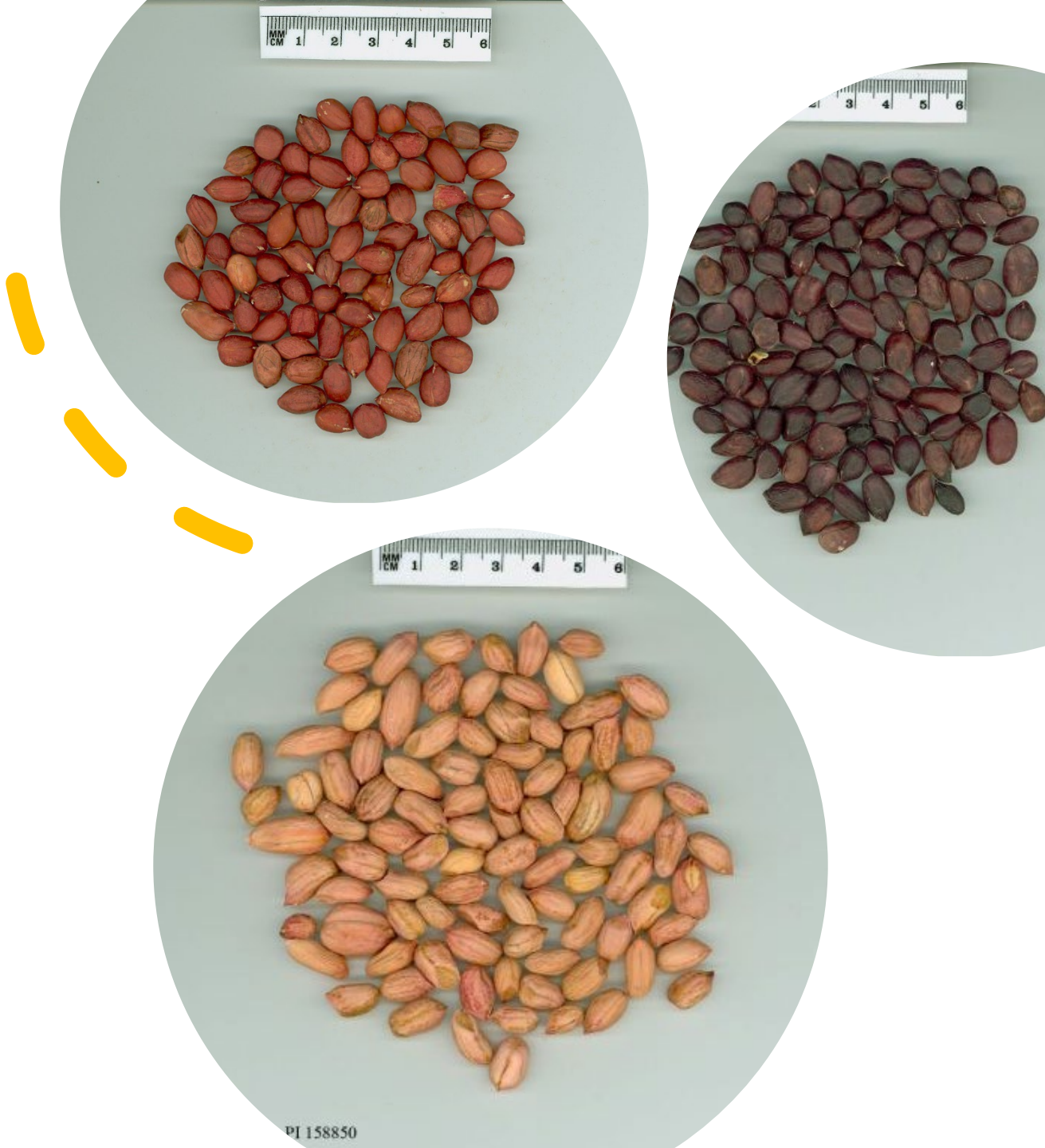


S-009 Activities

- The S-009 Regional Technical Advisory Committee met virtually on August 10, 2021, and was hosted by Virginia Sykes, 2021 S-009 Chair and Representative from Tennessee. The 2022 meeting is expected to be held in person in Griffin, GA and hosted by PGRCU and Soraya Bertioli, the 2022 Chair and Representative from Georgia.
- The Southern Association of Agricultural Experiment Station Directors voted to increase the S-009 budget by $61,329 to $572,899 to cover employee raises which was greatly appreciated.

Characterization and Evaluation

- Identification of germplasm resistant to peanut smut (Chamberlin et.al.; Peanut Science)
- Identification of QTLs for seed dormancy in cultivated peanut using a recombinant inbred line mapping population (Wang et.al.; Plant Molecular Biology Reporter; https://doi.org/10.1007/s11105-021-01315-5)
- Evaluation of leaf spot resistance in wild arachis species of section arachis (Massa et.al.; Peanut Science; https://doi.org/10.3146/PS20-25.1)
- A note on a Greenhouse evaluation of wild Arachis species for resistance to Athelia rolfsii (Bennett et.al.; Peanut Science; https://doi.org/10.3146/PS20-21.1)
- Insights into the genomic architecture of seed and pod quality traits in the U.S. peanut mini-core diversity panel (Patel et.al.; Plants; https://doi.org/10.3390/plants11070837)



Characterization and Evaluation

- Variability for oil, protein, lignan, tocopherol, and fatty acid concentrations in eight sesame (Sesamum indicum L.) genotypes (Morris et.al.; Industrial Crops and Products; https://doi.org/10.1016/j.indcrop.2021.113355)
- Multivariate analysis of butterfly pea (Clitoria ternatea L.) genotypes with potentially healthy nutraceuticals and uses (Morris; J.of Dietary Supplement; https://doi.org/10.1080/19390211.2021.2022821)
- Biobased Pesticide Discovery and Product Optimization and Enhancement from Medicinal and Aromatic Crops (Cantrell et.al., Processes; https://doi.org/10.3390/pr10020305)
- Discovery and characterisation of sweetpotato's closest tetraploid relative (Munoz-Rodriguez et.al.; New Phytologist; https://doi.org/10.1111/nph.17991)
- Characterization of Acetyl Coenzyme A inhibitor resistance in turfgrass and grassy weeds (Tate et.al., Crop Science; https://doi.org/10.1002/csc2.20511)
- Genomic mechanisms of climate adaptation in polyploid bioenergy switchgrass (Lovell et.al.; Nature Genetics; https://doi.org/10.1038/s41586-020-03127-1)

New Facilities Update

14-acre Land Lease to be established with the University of Georgia

Addition to house new cold room and freezer has been terminated. Plans are in place to refurbish existing cold room.

PGITRU (WRPIS) Curatorial & Research Programs

- Genetic resource management
  - Agronomy – grasses and safflower (vice-Reddy/C. Coyne)
    - Seeds of Success (BLM/ARS interagency project) – B. Irish
  - Bean – *Phaseoulous* spp. (vice-Kisha/B. Hellier)
  - Cool season food legumes – peas, chickpea, lentils, vetch and so on (C. Coyne)
  - Horticultural crops – lettuce, sugar beets, ornamentals, alliums, etc. (B. Hellier)
  - Temperate forage legumes – alfalfa, clover, trefoil, and more (B. Irish)
- Mission related RGR research/support
  - Research Leader – (Marilyn Warburton)
  - Alfalfa genetics NP 2015 – (Long-xi Yu)

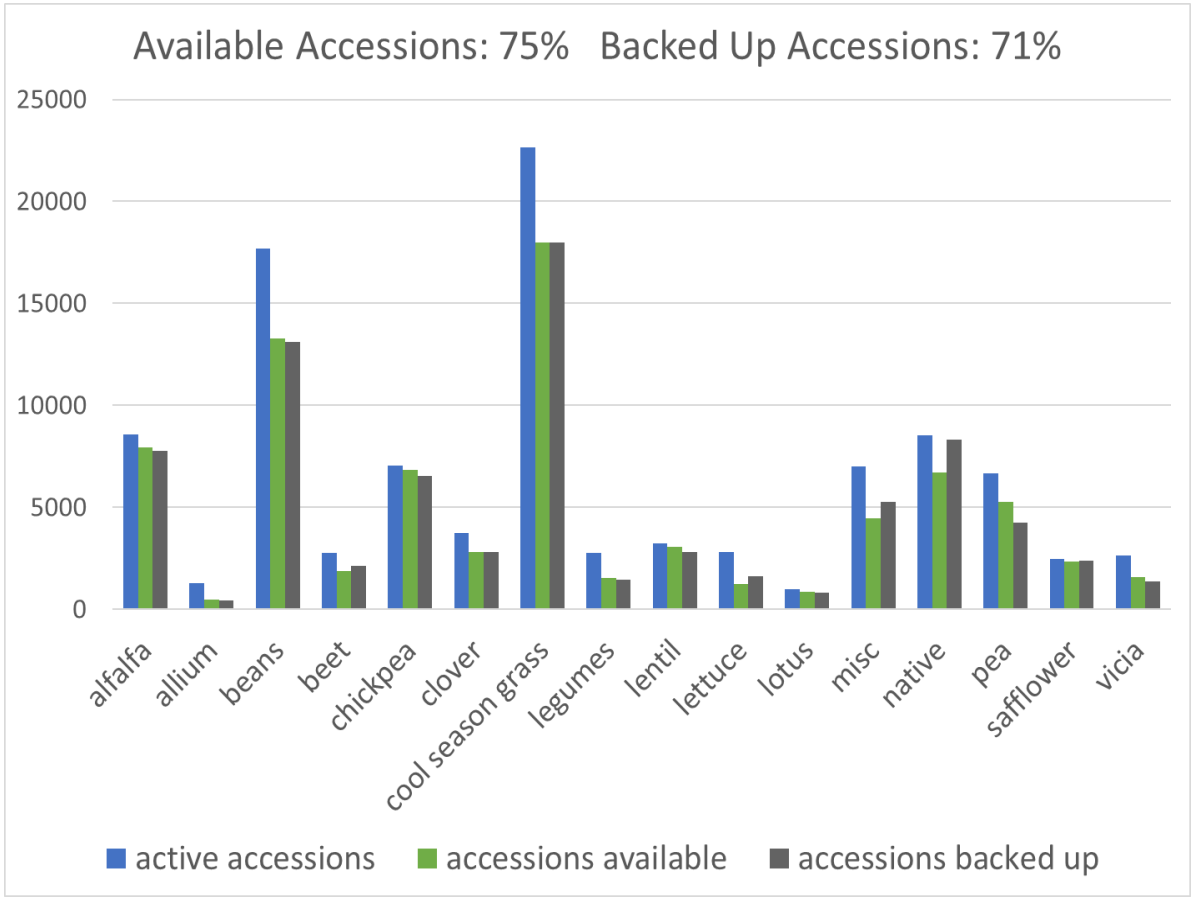
CRIS projects:

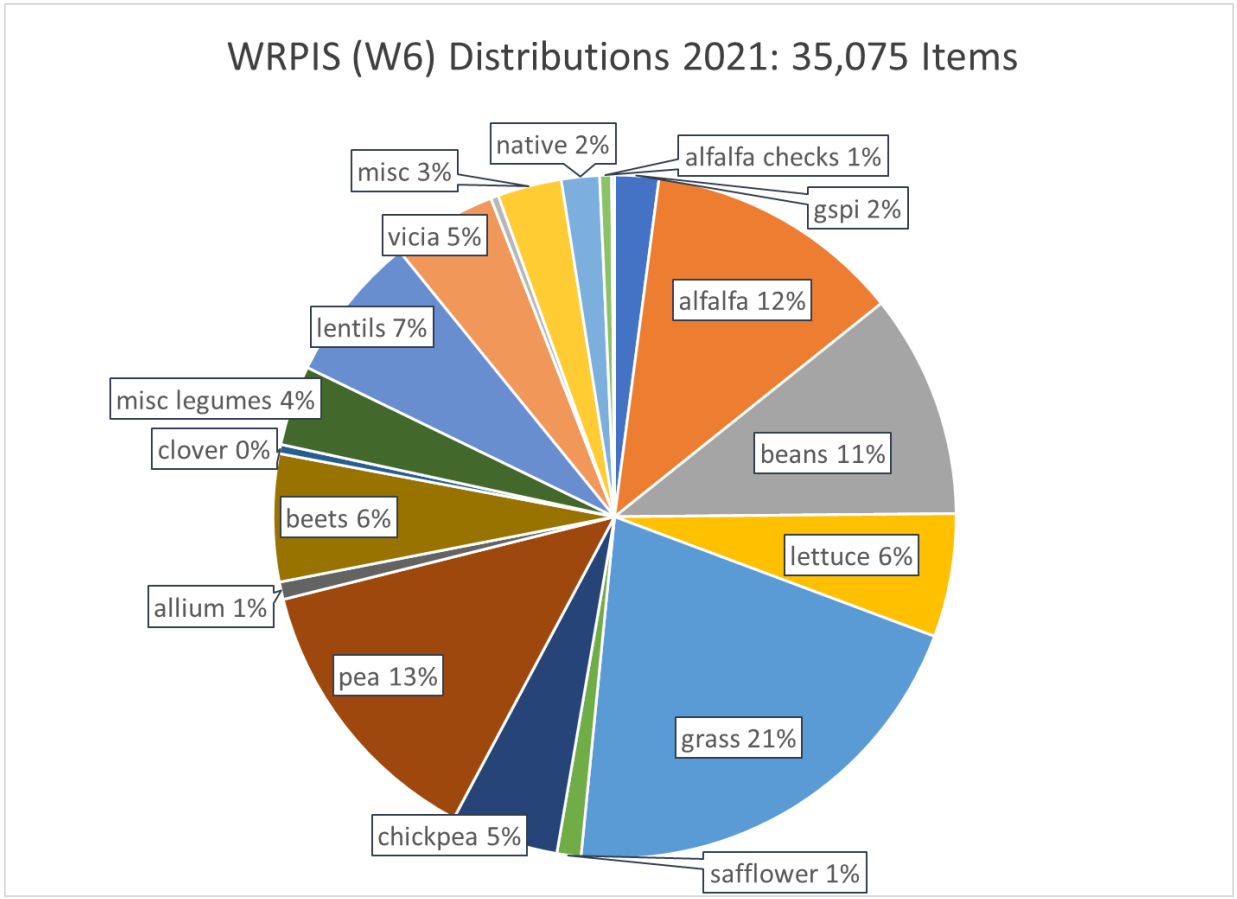
- 2090 21000 032 00 D
- 2090 21000 026 00 D
- 032 and 026 combined in 2023
- 2090 21000 036 00 D

Funding:

- $3,257,476 (2021) – Federal Appropriated
- $466,959 (2021) – W6 'in-kind' support
- Extramural funding/in-kind – RESEARCH

2021 PGITRU PGR Statistics





Program updates and challenges

- Our total full-time staff includes 28 ARS and 5 Washington State University people:
  - ⬆ We hired 3 scientists, including one Research Leader (Marilyn Warburton), an Agronomy curator (who resigned for personal reasons) and the Seeds Of Success term scientist (Bailey Hallwachs) and four technical staff (1 term) in the past 12 months
  - ⬇ We have 2 curator (Agronomy and Phaseolus) and 5 technical staff vacancies
- Improvement in the seed bank facilities, processes and GRIN Global data management:
  - ⬆ Purchased envelope printer for efficient labeling and 2 smaller Zebra printers for smaller orders and other labeling needs (inventories, address labels, etc.)
  - ⬆ Improved templates and conversion tools for GRIN Global data handling

Program updates and challenges

- Full-time staff: 28 USDA ARS and 5 Washington State University
  - ⬆ HIRED: 3 Scientists including Research Leader, Marilyn Warburton; Agronomy Curator (resigned for personal reasons) and Seeds of Success Support SY (Bailey Hallwachs) and 4 technical staff
  - ⬇ VACANCIES: 2 Curators (Agronomy and *Phaseolus*) and 5 technical staff
- Genebank facilities, processes and data management improvements
  - ⬆ Acquired envelope printer and two thermal printers for efficient labeling and smaller orders (inventories, address labels, etc.)
  - ⬆ Improved templates and conversion tools for GRIN-Global data handling

Program updates and challenges

- Moving out of Johnson Hall to Clark Hall on the WSU campus
  - Will have smaller and fewer labs and offices
  - This may curtail some activities for 2 – 3 years until the new ARS building is finished in 2025 (i.e., new genomics programs and visiting scientists/students)
- New ARS building cost overruns may reduce projected cold room space available after 2025
- W6 RTAC meeting was held on June 15, 2021 and run by Ian Ray (Chair), Kevin Jensen (Vice Chair), and Amjad Ahmad (Secretary). Reported updates from the ARS and partner institutions within the 13 western states. The next meeting will be July 6th (still virtually).

Horticultural Crops, *Beta* and *Phaseolus*

- Focusing on regeneration activities
  - Beta- field and greenhouse plots
  - Lettuce – *L. sativa* field nursery
  - Misc. collection – 4 field nurseries
  - Allium- seed plots and garlic
  - Phaseolus – Pullman and Central Ferry greenhouses
- Characterization of 30 sugarbeet accession to 6 plant pests/diseases
- *Phaseolus vulgaris* seed protein GWAS study.

Images clockwise from top left: PI 540597, *Beta maritima*; planting beet seedlings in Pullman; PI 259494,*Onobrychis viciifolia*; *Phaseolus* increase descriptor images; garlic planting in Pullman, WA; Alex Cornwall with *Lactuca sativa* transplants.

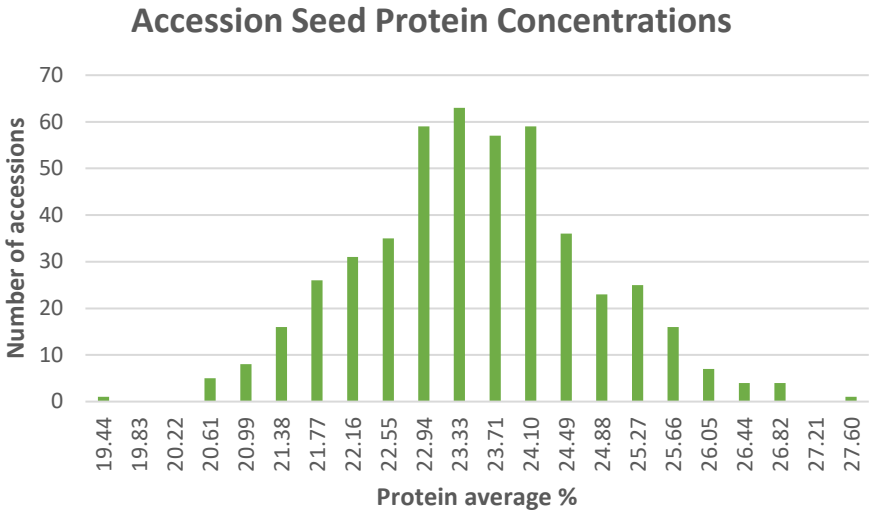
More Protein, More Peas, More Profit

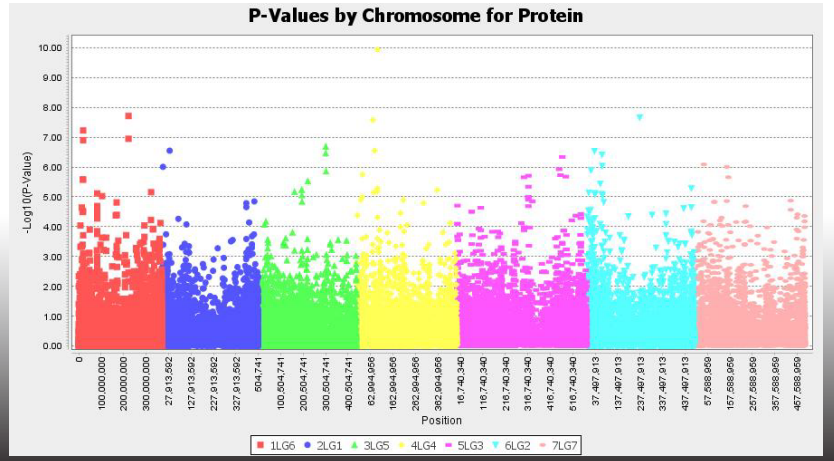
Clarice Coyne, Rebecca McGee (USDA), Chengci Chen (MSU), Dorrie Main, Yu Ma (WSU)

Research Goals: Identify pea lines with higher seed protein concentrations, define the genetics, provide breeders with DNA markers to speed the release of high pea seed protein cultivars.

Progress:

- 482 pea lines grown for three years (2019-2021) in replicated field trials to identify high protein lines
- 30 yellow pea cultivars grow in replicated field trials in two Montana locations
- Superior yellow pea lines identified for high protein concentration
- Preliminary DNA markers identified, markers will be verified with 2021 field trial data from Washington and Montana





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BREEDING
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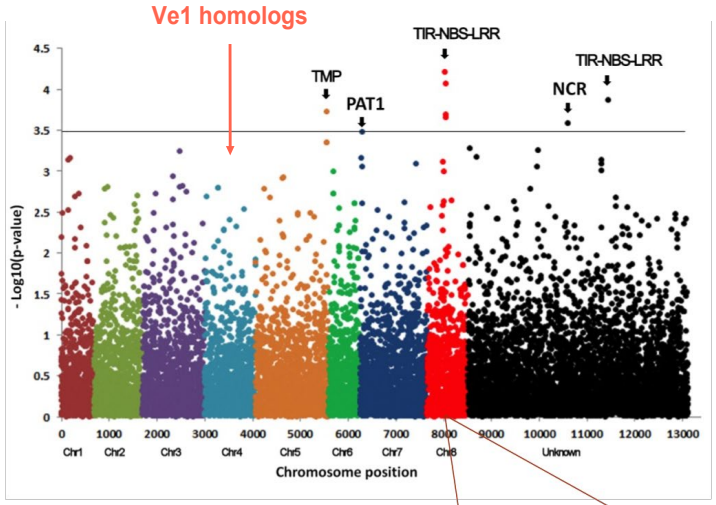
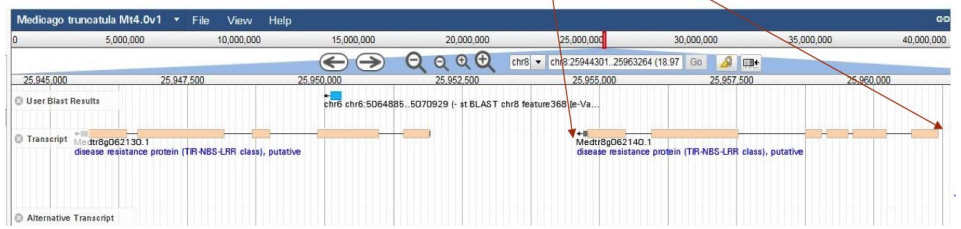
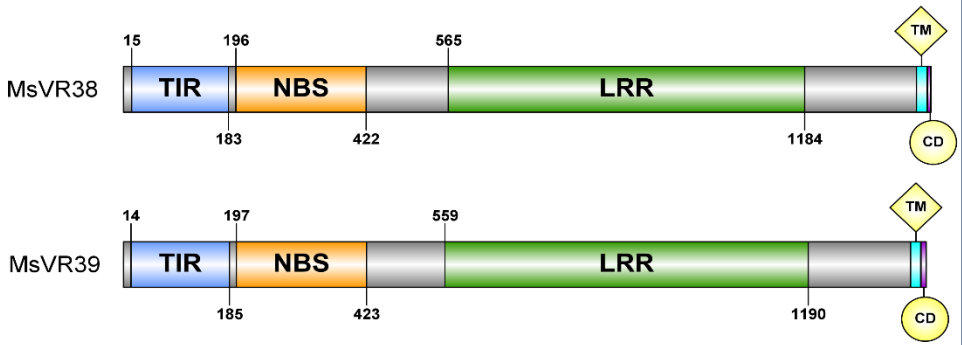
Two linked R were genes identified and functionally characterized







MsVR39 confers greater resistance to Verticillium wilt

Genomics-assisted breeding for drought and salt tolerant alfalfa