Banking Seeds for Future Needs

Colin Khoury
USDA Agricultural Research Service
National Laboratory for Genetic Resources Preservation
Fort Collins, Colorado

Photo: Neil Palmer
Some early proponents of diverse seeds in the USA

“The greatest service which can be rendered to any country is to add a useful plant to its culture; especially a bread grain. Next in value to bread is oil”
Thomas Jefferson, 1800
Origins and primary regions of diversity of major crops

Homesteaders in Wisconsin in 1895
Frank N. Meyer (1875-1918)

Photo: the World Today Magazine November 1909

Photo: Debra Roby
USDA ARS National Plant Germplasm System

- 579,000 accessions
- 15,000 species of plants
- >250,000 samples distributed annually
# Recipients of NPGS distributions 2017

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Number of samples</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. state agricultural experiment stations, universities, and state agricultural departments</td>
<td>81,575</td>
<td>30%</td>
</tr>
<tr>
<td>Foreign public organizations such as universities, embassies, institutes</td>
<td>61,976</td>
<td>23%</td>
</tr>
<tr>
<td>U.S. commercial seed/biotech/chemical companies with the destination inside the U.S.</td>
<td>37,876</td>
<td>14%</td>
</tr>
<tr>
<td>USDA ARS</td>
<td>36,858</td>
<td>14%</td>
</tr>
<tr>
<td>Foreign commercial seed/biotech/chemical companies with destination outside the U.S.</td>
<td>20,369</td>
<td>7%</td>
</tr>
<tr>
<td>U.S. individual without any organizational affiliation</td>
<td>18,523</td>
<td>7%</td>
</tr>
<tr>
<td>U.S. non-profit organization, such as botanical gardens, associations, societies</td>
<td>8,428</td>
<td>3%</td>
</tr>
<tr>
<td>Foreign national genetic resources program or genebank</td>
<td>3,670</td>
<td>1%</td>
</tr>
<tr>
<td>Foreign individual without any organizational affiliation</td>
<td>1,657</td>
<td>1%</td>
</tr>
<tr>
<td>Other U.S. federal organizations</td>
<td>712</td>
<td>0.3%</td>
</tr>
<tr>
<td>CGIAR International Agricultural Research Centers, FAO</td>
<td>188</td>
<td>0.07%</td>
</tr>
<tr>
<td>U.S. Agency for International Development (USAID)</td>
<td>103</td>
<td>0.04%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>271,935</strong></td>
<td></td>
</tr>
</tbody>
</table>

Data: USDA ARS NPGS, Quinn Sinnott, 2018
Annual seed distributions by major genebanks

- CGIAR (International) 11%
- USDA NPGS, USA 77%
- AGG, Australia 2%
- IPK, Germany 7%
- CGN, Netherlands 2%
- AAFC, Canada 1%
- JIC, UK 0%

CGIAR- no CIMMYT data, and doesn’t include distributions to CG breeding programs
Distributions (backups) in Svalbard Global Seed Vault not included for any genebank

Data: Colin Khoury, unpublished
Recipients of seed distributions by major genebanks

Data: Colin Khoury, unpublished

CGIAR- no CIMMYT data, and doesn’t include distributions to CG breeding programs
Distributions (backups) in Svalbard Global Seed Vault not included for any genebank
GRIN-Global – the information and ordering system

U.S. National Plant Germplasm System

Query Criteria:
Search String: Zea mays

Search For: Zea mays
Retrieve: Accessions

Accessions: Include unavailable, Include historic, With images, With NCBI link, With genomic data

Advanced Search Criteria
Return up to 500 accessions

Actions...
Select: All, None, Inverse, Highlighted
Options: Show 25 items

<table>
<thead>
<tr>
<th>Group By: Plant ID</th>
<th>Plant Name</th>
<th>Taxonomy</th>
<th>Origin</th>
<th>Material</th>
<th>Maintained By</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clze 38</td>
<td>CI 38B</td>
<td>Zea mays subsp. mays</td>
<td>United States</td>
<td>Seed</td>
<td>NC7</td>
<td>Add to Cart</td>
</tr>
<tr>
<td>NSL 38</td>
<td>MONTANA BLANCO</td>
<td>Zea mays subsp. mays</td>
<td>Colombia</td>
<td>Seed</td>
<td>NC7</td>
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<tr>
<td>NSL 39</td>
<td>MONTANA SEGREGATIONS</td>
<td>Zea mays subsp. mays</td>
<td>Colombia</td>
<td>Seed</td>
<td>NC7</td>
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<tr>
<td>Clze 40</td>
<td>CI 40A</td>
<td>Zea mays subsp. mays</td>
<td>United States</td>
<td>Seed</td>
<td>NC7</td>
<td>Add to Cart</td>
</tr>
<tr>
<td>NSL 40</td>
<td>CABUYA AMARILLO</td>
<td>Zea mays subsp. mays</td>
<td>Colombia</td>
<td>Seed</td>
<td>NC7</td>
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<tr>
<td>NSL 41</td>
<td>IMBRICADO BLANCO</td>
<td>Zea mays subsp. mays</td>
<td>Colombia</td>
<td>Seed</td>
<td>NC7</td>
<td>Add to Cart</td>
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</table>

https://npgsweb.ars-grin.gov/gringlobal/search.aspx
Maintenance and characterization
Evaluating young wild apple seedlings for resistance to apple scab

A-type resistance ‘chlorotic’

B-type resistance ‘stellate necrotic’
Use of NPGS germplasm

Cotton

• Reniform nematode
• NPGS accession of an African wild cotton identified, crossed with cultivars, released to breeders
• Estimated value $5.5 billion (2012)

Peanut

• Tomato spotted wilt virus, late leaf spot, southern stem rot
• NPGS accession collected in market in Brazil in 1952 found to have excellent resistance
• University of Florida 1970s-1980s - incorporated into >20 cultivars. Grandparent of Georgia Green (University of Georgia)
• Resistance estimated value >$250 million annually
Use of NPGS germplasm

Apple Cider and Perry

• Increasing requests for the apple collection by the growing hard cider industry
• NPGS major source of varieties for perry production in Oregon, which grew 5-6 fold from 2005 -2013

Tropical fruits in Puerto Rico

• 2017 hurricanes completely destroyed major fruit production areas
• NPGS repository in Mayaguez PR providing seed for rootstocks and budwood of quality fruit trees (cacao, rambutan, mamey sapote, mangosteen) to producers
Note: Deflator for 2015 is preliminary
USDA ARS
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American native crop genetic resources

Salinity tolerance from Pecos sunflower (*Helianthus paradoxus*)

Western corn rootworm resistance from eastern gama grass (*Tripsacum dactyloides*)

Eastern filbert blight resistance from American filbert (*Corylus americana*)

Rootstock from northern California walnut (*Juglans hindsii*)

Thank you!

colin.khoury@ars.usda.gov


NPGS questions?
National Program Leader - Peter Bretting
Peter.Bretting@ars.usda.gov

Photo: Neil Palmer