How to be a guardian of the genetic diversity of one of the world's most important crop plants: My first three years at the CIMMYT Maize Germplasm Bank in Mexico

Denise E. Costich
What is germplasm?

living tissue from which new plants can be grown

Photos: SeedQuest, Crop Genebank Knowledge Base
Why do we preserve germplasm?

To ensure the survival of the genetic diversity in the world’s major crop species and their wild relatives, so that this essential resource remains available for use by current and future generations.
The Global Network of International Banks
The Global Network of International Banks

- **MAIZE & WHEAT**
- **BEANS & FORAGES**
- **POTATOES & ANDEAN TUBERS**
- **RICE**
- **CASSAVA**
- **MAIZE**
- **BANANAS**
- **FORAGES**
- **LEGUMES, WHEAT**
- **CEREALS**
- **TREES**
- **ALL CROPS—ALL BANKS**

The map shows the global distribution of various crops and their associated international banking networks.
Who are the gene bankers?

It is an invisible, apolitical band of dedicated researchers around the world who maintain these gene bank insurance policies. They walk in the footsteps of Vavilov, who died of starvation in prison during World War II, while his staff suffered a similar fate during the Siege of Leningrad rather than compromise the seeds they had saved for humanity.

--Luigi Guarino, Global Crop Diversity Trust
The Story of the ICARDA Germplasm Bank
(International Center for Agricultural Research in the Dry Areas)

- Located in Aleppo, Syria
- All international staff evacuated due to civil war
- Local staff carried on, kept the collection safe AND completed the back-up
The Story of the ICARDA Germplasm Bank
(International Center for Agricultural Research in the Dry Areas)

- Relocated to Morocco & Lebanon
- Back-up collection at CIMMYT being sequenced
- Back-up at Svalbard retrieved
- Now being regenerated in Morocco & Lebanon
The Global *ex situ* collection of Maize = 305,318 accessions in 281 banks*

<table>
<thead>
<tr>
<th>Bank</th>
<th>Country</th>
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<tbody>
<tr>
<td>CIMMYT</td>
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<td>México</td>
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Mandate of the CIMMYT Maize Bank:

• Providing secure, long-term storage for critical maize genetic resources;
• Facilitating their use to solve practical breeding problems;
• Improving knowledge about genetic diversity;
• Developing and assessing complementary strategies for in situ and ex situ conservation;
• Exploring genetic diversity at the molecular level;
• Helping develop global databases on maize genetic resources.
The work of the bank is very diverse....

- Pollinations
- Characterization
- Studying diversity
- Preparing orders
- Germination
- Testing
- Storage
- Regenerations
- Participating in workshops
Infrastructure that organizes the flow of seed and information

INTRODUCTIONS

REGENERATION

SEED PROCESSING

CONSERVATION

SEED DISTRIBUTION

BACK-UPS (Svalbard, Ft. Collins)

MEDIUM TERM (Active)

LONG TERM (Base)
CIMMYT Wheat & Maize Banks ISO Certified in 2012 and renewed in 2015

One of only four germplasm banks globally to achieve certification and the first outside of Europe!
CIMMYT
Seed Storage Vaults

- Inaugurated in 1996
- Earthquake-proof
- Active collection @ ground level
  - Temperature = 0° C
  - Rel. humidity = 25-30%
  - Seed viability ~ 25-30 years
- Base collection (belowground)
  - Temperature = -18° C
  - Humidity not controlled
  - Seed viability > 50 years
Re-labelling the Entire Collection – 28,000+ Flasks in Active Vault

- Out-dated, unreadable barcoding
- Inventory needed updating
- Curation of passport information required
Re-labelling the Entire Collection – 28,000+ Flasks in Active Vault

- New 2D barcode links directly to database
- Inventory (weights) updated
- Passport data curated
- Fields in label fully compatible with wheat collection to allow the databases to be merged
Regeneration

- 4-5 cycles/year in 3-4 agroenvironments
- We regenerate an accession when—
  - The quantity of seed is <500 gm
  - The germination rate is <85%
- Controlled pollinations ("plant to plant")
- 80-100 healthy ears = successful regeneration
Maize Pollination 101

TASSEL (Male) → EARS (Female)
Pollination → Harvest
Information about the collection is available online

http://mgb.cimmyt.org/gringlobal/search.aspx
Anyone can order seed online

http://www.cimmyt.org/obtainseed
Distribution Statistics: (2015 in detail)

Numbers of envelopes

<p>| | |</p>
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<tr>
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<tbody>
<tr>
<td>Internal</td>
<td>2036</td>
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<tr>
<td>External</td>
<td>3142</td>
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Users

- CIMMYT Researchers & Breeders
- National Ag Research Institutes
- Educators
- Farmers
- Industry
### Distribution Statistics: (2015 in detail)

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12.6% of the collection

#### Users

- CIMMYT Researchers & Breeders
- National Ag Research Institutes
- Educators
- Farmers
- Industry
Highland Maize Field Day
Toluca Station ● 21 November 2014

Programa
- Bienvenida
- Introducción
- Objetivo
- Recorrido de campo
- Comida

Invitación
El Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT) y el Instituto de Investigación y Capacitación, Agropastoril, Acuícola y Forestal del Estado de México (ICAMEX) les hacen una CORDIAL INVITACIÓN.

Para asistir al evento de demostración de maíces de altura, donde podrá visualizar variedades mejoradas del CIMMYT, criollos sudamericanos y mexicanos que están resguardados en el Banco de Germoplasma de Maíz de CIMMYT.

LUGAR:
Estación Experimental de Toluca-CIMMYT.

Dirección: Calle Hidalgo s/n Col. San Sebastián, Metepec Edo. De México

FECHA:
Viernes, 21 de noviembre del 2014, a partir de 10:00 horas.
Highland Maize Field Day
Toluca Station • 21 November 2014
Final Products 2014—CIMMYT-ICAMEX

Farmers’ Selections

<table>
<thead>
<tr>
<th>Rank</th>
<th>Accs. Names</th>
<th>Grade</th>
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<tbody>
<tr>
<td>1</td>
<td>TOLUCA 8786</td>
<td>58.0</td>
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<tr>
<td>2</td>
<td>Salpor X Cacahuacintle</td>
<td>51.3</td>
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<td>3</td>
<td>TLAX 88</td>
<td>50.6</td>
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<tr>
<td>4</td>
<td>POOL 3A TOL</td>
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<td>5</td>
<td>Comp. Cacahuacintle</td>
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<td>6</td>
<td>MEXI 314</td>
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<td>7</td>
<td>TOLUCA 8889</td>
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<td>8</td>
<td>POBLAC 920 C3</td>
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<tr>
<td>9</td>
<td>POOL 1A TOL</td>
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<tr>
<td>10</td>
<td>MEXI 55</td>
<td>37.8</td>
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<tr>
<td>11</td>
<td>COMP. CONICO PALOMERO TOLUQUEÑO</td>
<td>35.7</td>
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<tr>
<td>12</td>
<td>POOL 7A BAT</td>
<td>34.5</td>
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</table>
### New Farmers’ Selections

<table>
<thead>
<tr>
<th>Acc. names</th>
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<tbody>
<tr>
<td>V.E.AM DU. F3</td>
<td>Ecuador</td>
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<tr>
<td>POOL 1a TOL</td>
<td>México</td>
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<tr>
<td>HxCBA1401 E2</td>
<td>México</td>
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<tr>
<td>SCxCB14 C3-5</td>
<td>México</td>
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<tr>
<td>HPOOL6C1 x HPOOL5C1</td>
<td>México</td>
</tr>
<tr>
<td>HPOOL8C1 x HPOOL7C1</td>
<td>México</td>
</tr>
<tr>
<td>Compuesto Cacahuacintle</td>
<td>México</td>
</tr>
<tr>
<td>Salpor X Cacahuacintle</td>
<td>México</td>
</tr>
<tr>
<td>HPOOL2C0 x HPOOL1C0</td>
<td>México</td>
</tr>
<tr>
<td>HPOOL7C1 x HPOOL8C1</td>
<td>México</td>
</tr>
<tr>
<td>ACROSS 8810</td>
<td>Ecuador</td>
</tr>
<tr>
<td>INIAP 180</td>
<td>Ecuador</td>
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Productos Finales 2015—CIMMYT-ICAMEX

Seed increment of the 12 most popular accessions for on-farm trials in 2016
Community Seed Reserves and recovering “lost” diversity in the Guatemalan Highlands: The Buena Milpa Project
Community Seed Reserves and recovering “lost” diversity in the Guatemalan Highlands: The Buena Milpa Project
First visit to Buena Milpa Project in Guatemala Nov. 2015
Evaluating Community Seed Reserve Candidates

- Concepción Chiquirichapa
- Warsovia
- Igualdad
CIMMYT Maize Bank Staff preparing seed shipment for Guatemala
25 February 2016
We have the seed, the expertise, and the mandate...

We hope to help farmers like these...
Thank you for your interest!