CIMMYT Global Maize Program
– Continuous Improvement & Change Management

B.M. Prasanna
with Mike Olsen, Aparna Das &
GMP Team & Partners
Evolution of CIMMYT Maize Breeding

1966
- Classifying, sorting and forming populations
- Intl. Maize Adaptation Nurseries

1972
- Pools and Populations
- Improving plant type
- On-farm testing

1985
- Hybrid breeding program
- Megaenvts.
- Stress tolerance
- Germplasm conservation

1995
- Inbred-hybrid approach
- CIMMYT hybrid trials (since 1994)
- Pedigree selection using biparental populations.
- Applied biotech.

2007
- Initiation of DH and transgenic maize work
- Maize breeding revived in Asia

2011
- Marker-assisted breeding
- Stronger seed systems team
- IMIC
- Defending genetic gains from major threats
“The pessimist complains about the wind. The optimist expects the wind to change. The realist adjusts the sails.”

- William A. Ward
CIMMYT Global Maize Program
Continuous Improvement

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EXCELLENCE IN BREEDING ENGAGEMENT

- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
Support through EiB

- Refining product concepts and targets, and Product advancement (George Kotch, Bish Das)
- Breeding program costing (Bish Das, Steve Cosak & Gustavo)
- Phenotyping site improvement, and mechanization of breeding operations (Steve Cosak & Gustavo)
- Heterotic grouping and improving breeding efficiency (Randall Holley)
- Selection indices and QG support for product advancement (Eduardo & Johannes Martini)
- Genotyping workflow (Mike Olsen)
- Data management (Kelley Robbins, Tom Hagen & Kate Dreher)
Maize Product Profiles for ESA, LatAm, and S Asia

- Relook at the markets, and determining comparative advantage and unique value of our breeding products
- Assessing the partnership network to achieve the breeding targets
- Prioritizing must-have, value-added traits for enhancing potential impact of our products in the target markets

Regional Workshops on Maize Product Profiles and Varietal Turnover:
- Eastern Africa (Nairobi; Aug 29-30)
- Southern Africa (Harare; Oct 21-22)
- South Asia (Nepalganj; Sept 27-28)
- Latin America (Mexico; Oct 30-31)

Partners’ Feedback
- Product prioritization for different Geographies;
- Market demand for specific traits

Selection Indices (based on market/economic weights for traits)
Regional Phenotyping/Testing Networks in Partnerships with both Public and Private Sector Institutions

Impacts across Borders

MasAgro-Maize Consortium Testing Network in Targeted Markets

Abiotic Stress Phenotyping Network in ESA

Heat Stress Phenotyping Network in South Asia (based on VPD)
Regional Platforms for Efficiency-at-Scale & Collective Impact

KALRO-CIMMYT Partnership

Since 2015, 134,755 DH lines from 843 populations (159 DH lines per population)

Several new CMLs and Hybrids based on DH parents

Process improvement leading to increase in HIR, reduction in false positives, and doubling efficiency → reduction in cost per DH unit.

~200,000 germplasm entries (~300,000 rows) screened against MLN under artificial inoculation at the Naivasha facility since 2014.

Of these, 61% from CIMMYT, 17% from NARS, and 22% from the private sector.
Breeding Program Costing

- Nursery costs at different breeding hubs
- Phenotyping service costs (abiotic stresses, biotic stresses)
- Quality analysis in specific product profiles
- Marker applications
- On-station trial costs
- Seed system costs (seed production research, on-farm trials, breeder seed production, etc.)
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<td>MABC: MLN + SPT stack (Corteva)</td>
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**EXCELLENCE IN BREEDING ENGAGEMENT**
CIMMYT’s Maize Product Advancement Process

**Stage I & II**
- **Stage III (Multi-environment Testing)**
- **Stage IV (Regional Testing)**
- **On-farm trials, parental trials & seed production**
- **National Performance Trials (NPT)**
- **Prod. Registration/Commercialization**

**Line Dev. Breeders**
**Product Development Breeders**
**Seed Systems Team**
**NARS/Seed Companies**

**Marker applications**

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- CML Release Process Formalized
- Stage-Gate System Implemented
- Product Allocation Process Harmonized
- CML Release Process Updated
- Stage-Gate System Updated in ESA (including STG 5: ROFVT)
- STG 3 to 4 Adv Meeting including key NARS Partners

Optimum, 2000-2018

\[ y = 0.1239x + 6.8359, \quad R^2 = 0.5915 \]
Genetic gain = 1.81%

nLoc=15, H=0.89

Low N stress, 2000-2018

\[ y = 0.0645x + 2.9679, \quad R^2 = 0.7297 \]
Genetic gain = 2.17%

nLoc=8, H=0.89

Random stress, 2000-2018

\[ y = 0.0756x + 4.1299, \quad R^2 = 0.5881 \]
Genetic gain = 1.83%

nLoc=9, H=0.89

Drought stress, 2000-2018

\[ y = 0.0633x + 2.9868, \quad R^2 = 0.752 \]
Genetic gain = 2.12%

nLoc=6, H=0.88

A. Optimum

Grain yield (t/ha) vs. Year of release/selection

\[ y = 0.0906x + 7.0348 \]

\[ R^2 = 0.3008 \]

B. Managed low N

Grain yield (t/ha) vs. Year of release/selection

\[ y = 0.057x + 1.9733 \]

\[ R^2 = 0.2447 \]

C. Managed drought

Grain yield (t/ha) vs. Year of release/selection

\[ y = 0.047x + 1.876 \]

\[ R^2 = 0.2001 \]

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<th>Gain kg/ha/yr</th>
<th>GG (%)</th>
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<td>Optimum</td>
<td>17</td>
<td>91</td>
<td>1.29</td>
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<td>Low N</td>
<td>6</td>
<td>57</td>
<td>2.89</td>
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<td>Managed DRT</td>
<td>5</td>
<td>47</td>
<td>2.51</td>
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Genetic Gain: LatAm Tropical White Program

![Graph showing genetic gain over years with equations and data points for different CIMMYT and CLTHY lines.](image-url)
International Maize Improvement Consortium (IMIC)

IMIC-Asia (since 2011)

IMIC-LatAm (since 2011)

IMIC-Africa (since 2018)

• Pulse of the clients
• Expanded our collaborative testing network
• Shifted focus from trait-based breeding to developing commercially viable products
• Platform for CapDev of both NARS and SME seed company partners in maize breeding
CIMMYT’s Maize Varietal Identification Number

Varietal Identification Number (VIN) for each of our unique products licensed to partners in SSA, Asia and LatAm since 2017.

• VIN is an integral part of our Product Licensing Agreement

• Example of CIMMYT VIN: CIM18MHS##
Implementing Go-to-Market Strategy in Partnership
Example: DT + MLN Hybrid in Uganda
Stress Tolerant Maize for Africa
Are we achieving scale and impacts?

- From <6000 tons in 2007 to >85,000 tons of certified maize seed produced (annually) and delivered in 2019 by partners across SSA (despite MLN and FAW outbreaks!)
- Estimated area in 2019 under CGIAR-derived stress tolerant maize in SSA: 3.3 M ha
- Target: 150,000 tons by 2024; 6.2 M ha
Thanks!

- MAIZE Partners in Africa, Asia and LatAm, and CIMMYT colleagues for their commitment to the mission, and willingness to keep adjusting the sails!
- BPAT and EiB Management Team
- Funding agencies, especially B&MGF, USAID, DFID, BMZ, SFSA, and MAIZE CRP.

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