

# **CIMMYT Global Maize Program – Continuous Improvement & Change Management**

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**with Mike Olsen, Aparna Das &  
GMP Team & Partners**



RESEARCH  
PROGRAM ON  
Maize

# Evolution of CIMMYT Maize Breeding

1966

1972

1985

1995

2007

2011

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

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

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

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

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

- 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

	2011	2012	2013	2014	2015	2016	EXCELLENCE IN BREEDING ENGAGEMENT				
Strengthening Seed Systems Team											
IMIC in Asia, LatAm & Africa	★	★						★			
Trait Pipeline Coordination											
Maize DH Service in SSA & LatAm			★								
Role Specialization											
Trait Integration (MAS & Transgenes)											
MLN Phenotyping Service				★							
Product Advancement Meetings											
High-throughput Phenotyping											
Product Manager (Latin America)						★					
Refining Product Profiles											
BPAT & Maize Improvement Plan											
Product Manager (Africa)											
Breeding Program Costing & Refinement											
Further Strengthening Phenotyping and Breeding Efficiencies											

# 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 (Nepalgunj; Sept 27-28)
- Latin America (Mexico; Oct 30-31)



## Partners' Feedback

- Product prioritization for different Geographies;
- Market demand for specific traits



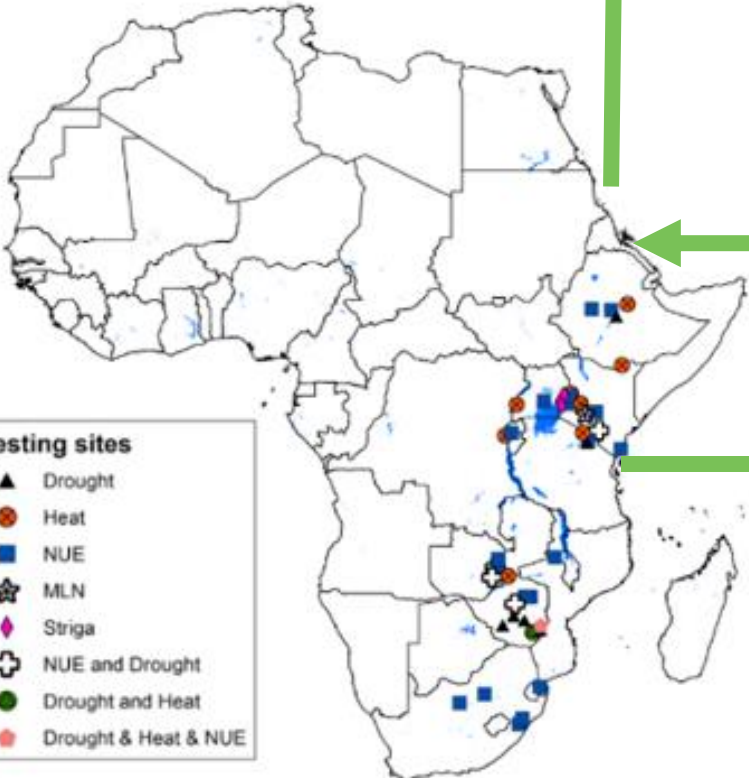
**Selection Indices (based on market/economic weights for traits)**



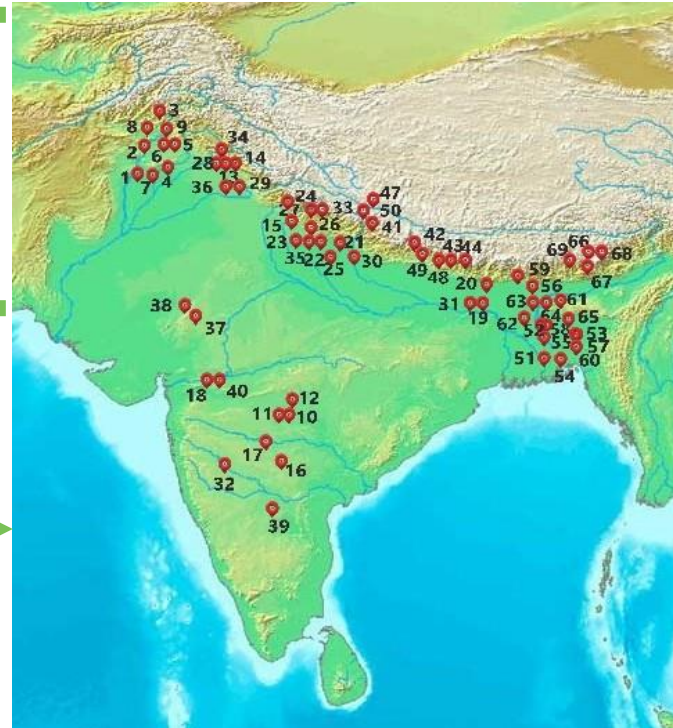
# Regional Phenotyping/Testing Networks in Partnerships with both Public and Private Sector Institutions Impacts across Borders



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



Maize DH Facility at Kiboko, Kenya

- 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.



MLN Screening Facility at Naivasha, Kenya

- **~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



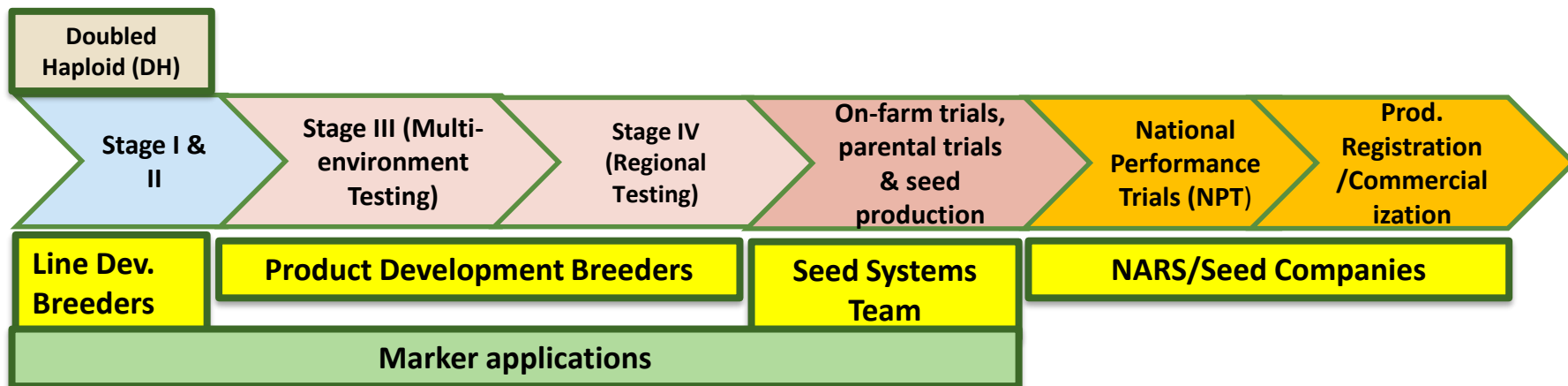
- Nursery costs at different breeding hubs
- Phenotyping service costs (abiotic stresses, biotic stresses)
- Quality analysis in specific product profiles
- Marker applications
- On-station trial costs
- Seed system costs (seed production research, on-farm trials, breeder seed production, etc.)

# CIMMYT-GMP Genotyping Workflows

	EXCELLENCE IN BREEDING ENGAGEMENT									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Forward Breeding: PVA	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
MABC: Bt/DT (Monsanto)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Forward Breeding: MSV	White	White	Green	Green	Green	Green	Green	Green	Green	Green
MABC: MLN	White	White	Green	Green	Green	Green	Green	Green	Green	Green
MABC: Ms44 (DuPont Pioneer)	White	White	White	Green	Green	White	White	White	White	White
Forward Breeding: MLN	White	White	White	Green	Green	Green	Green	Green	Green	Green
Forward Breeding : qHIR1	White	White	White	Green	Green	Green	Green	Green	Green	Green
MABC: Ms44_SPT (DuPont Pioneer)	White	White	White	Green	Green	Green	Green	Green	Green	Green
Gene Editing: MLN (Corteva)	White	White	White	White	Green	Green	Green	Green	Green	Green
Breeding Pipeline Genetic QC/QA	White	White	White	White	White	Green	Green	Green	Green	Green
Genomic Selection	White	White	White	White	White	White	Green	Green	Green	Green
MABC: MLN + SPT stack (Corteva)	White	White	White	White	White	White	White	Green	Green	Green



# CIMMYT's Maize Product Advancement Process

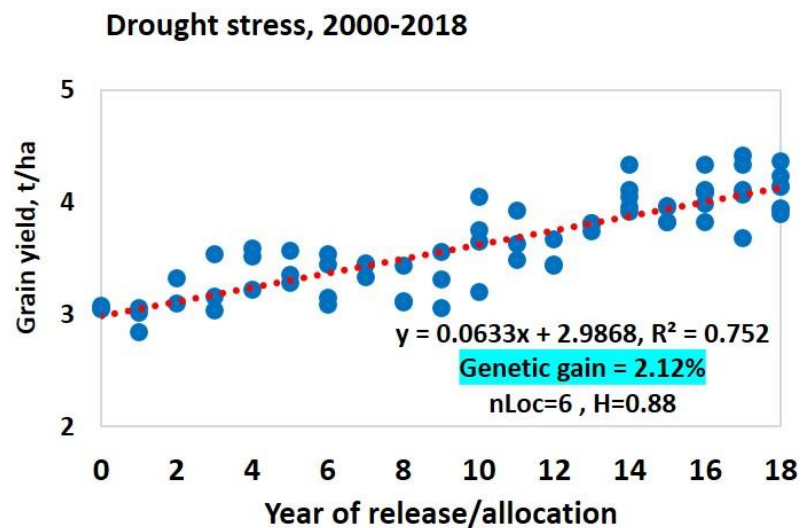
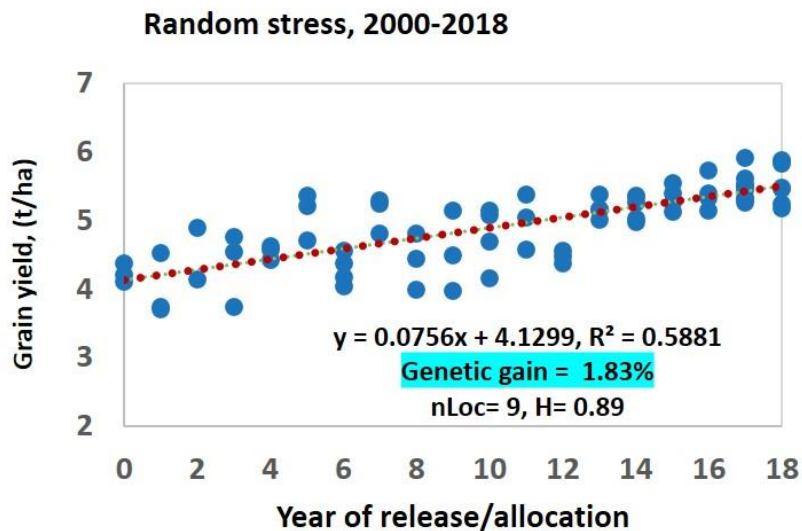
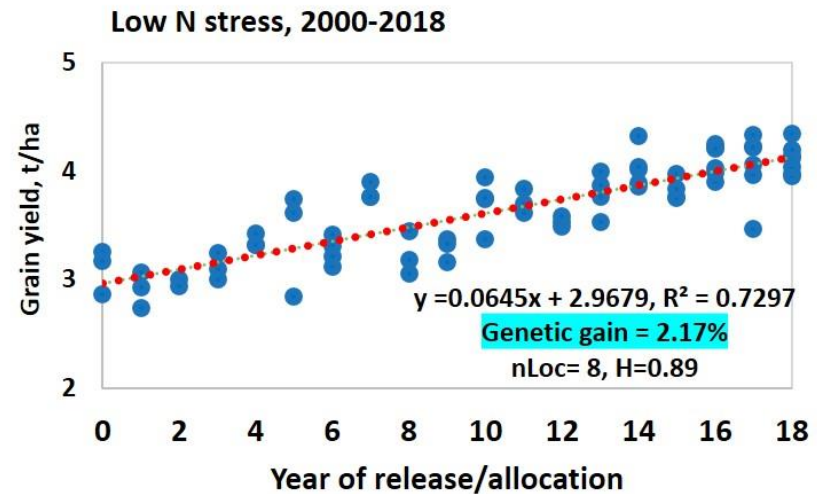
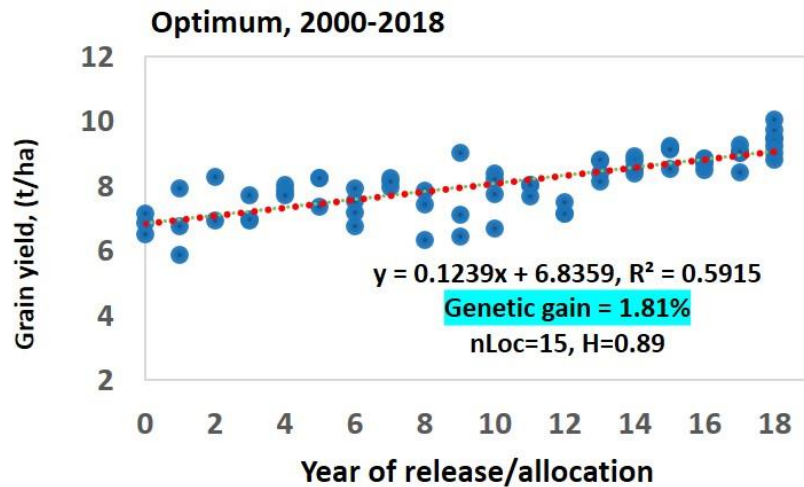


	EXCELLENCE IN BREEDING ENGAGEMENT							
	2013	2014	2015	2016	2017	2018	2019	2020
CML Release Process Formalized								
Stage-Gate System Implemented								
Product Allocation Process Harmonized								
CML Release Process Updated								
Stage-Gate System Updated in ESA (including STG 5: ROFVT)								
STG 3 to 4 Adv Meeting including key NARS Partners								



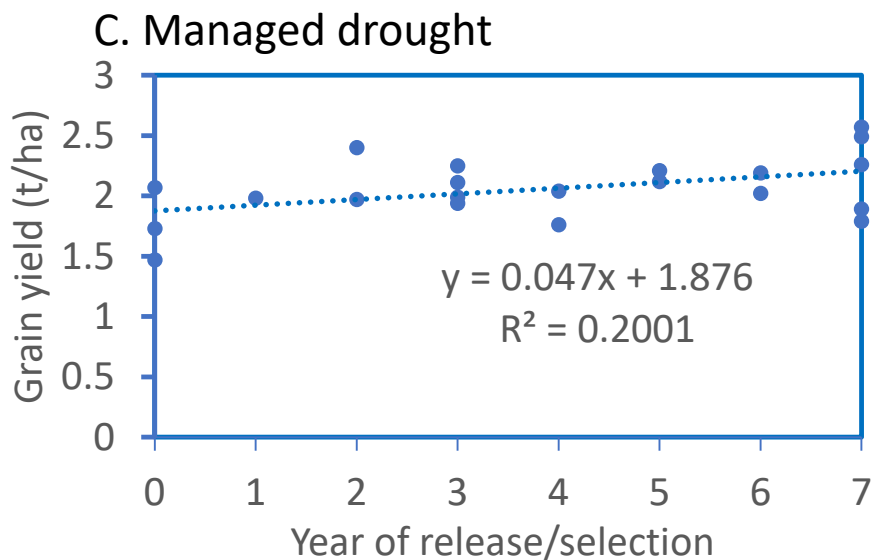
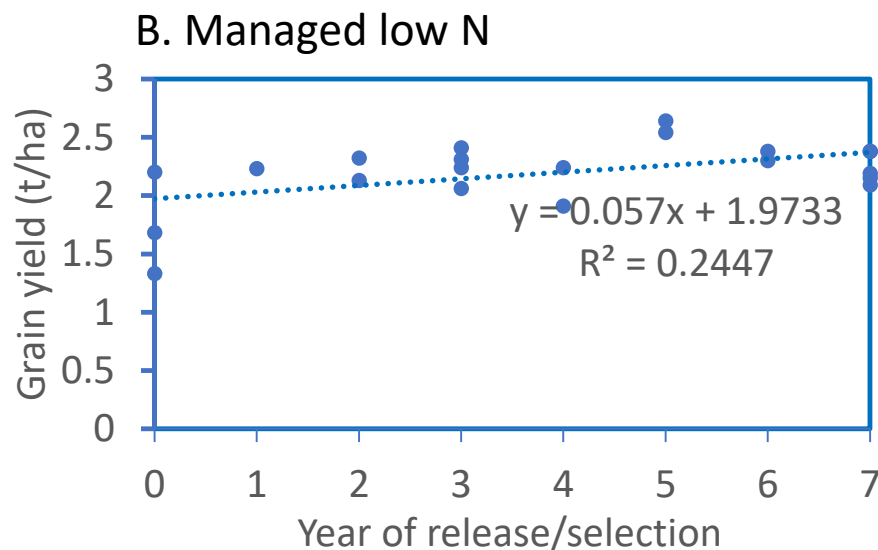
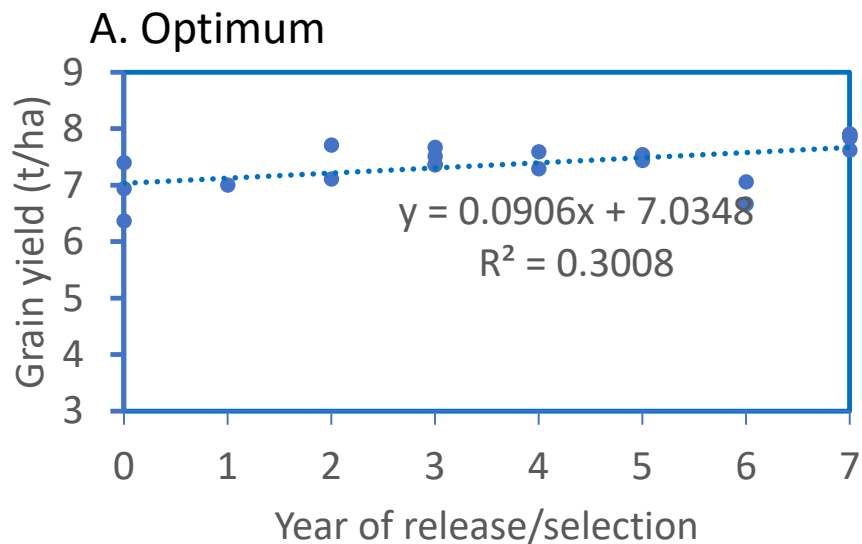
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# Genetic Gains in CIMMYT Southern Africa Early Maturing Maize Hybrids (2000-2018)



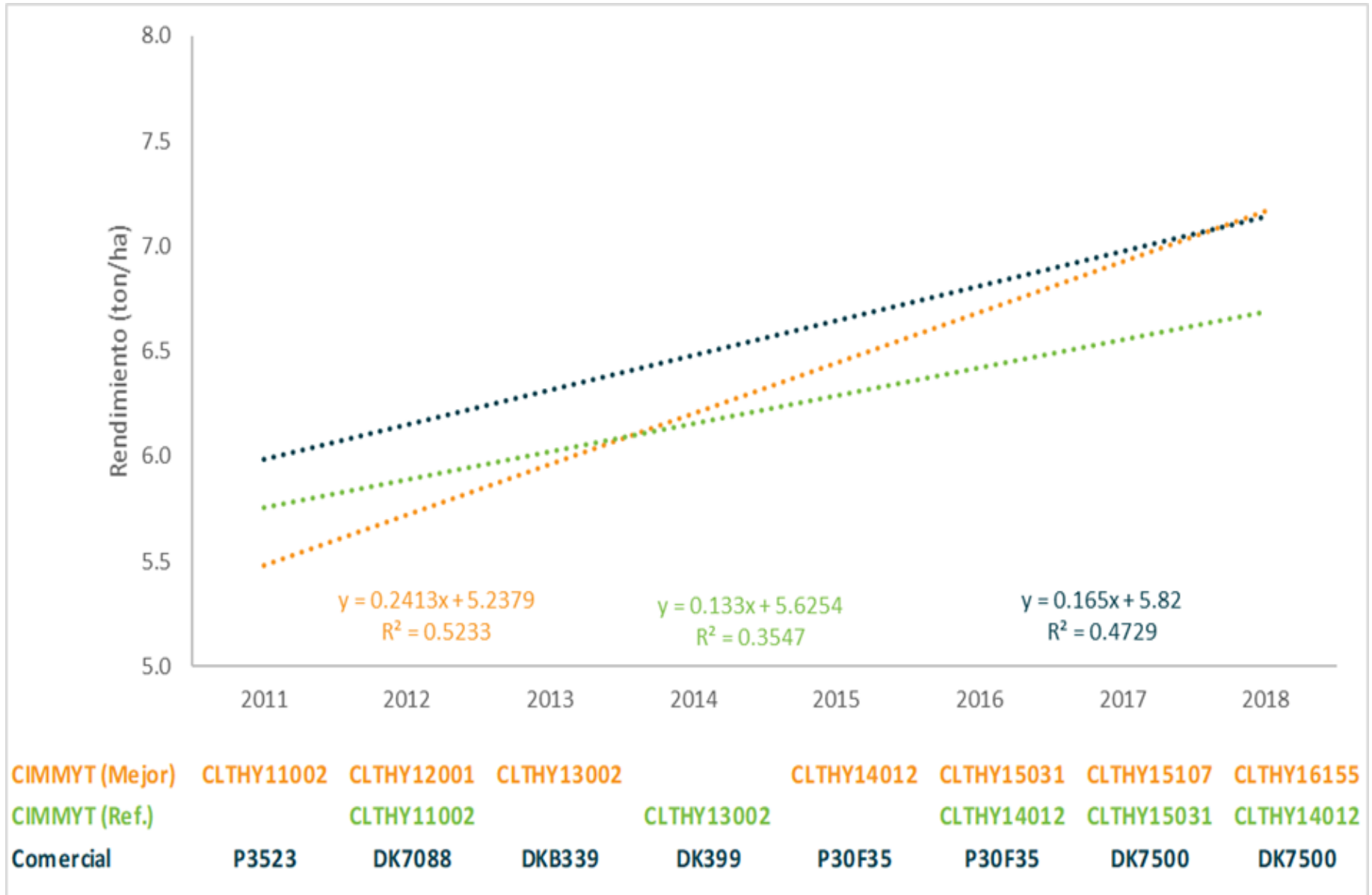


# Genetic Gains in CIMMYT Southern Africa Intermediate Maturing Maize Hybrids (2013–2019)



Management	nLoc	Gain kg/ha/yr	GG (%)
Optimum	17	<b>91</b>	<b>1.29</b>
Low N	6	<b>57</b>	<b>2.89</b>
Managed DRT	5	<b>47</b>	<b>2.51</b>

# Genetic Gain: LatAm Tropical White Program



# 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.

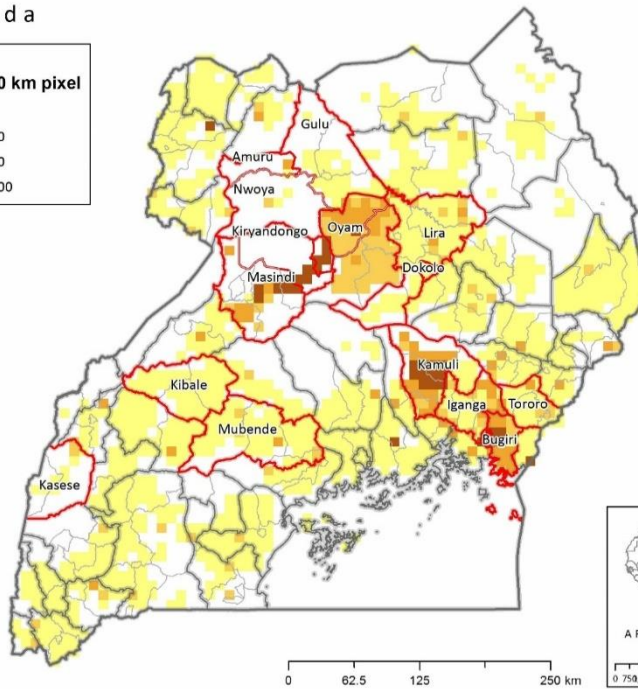
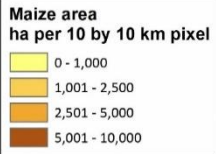
- VIN is an integral part of our Product Licensing Agreement
- Example of CIMMYT VIN: **CIM18MHS##**



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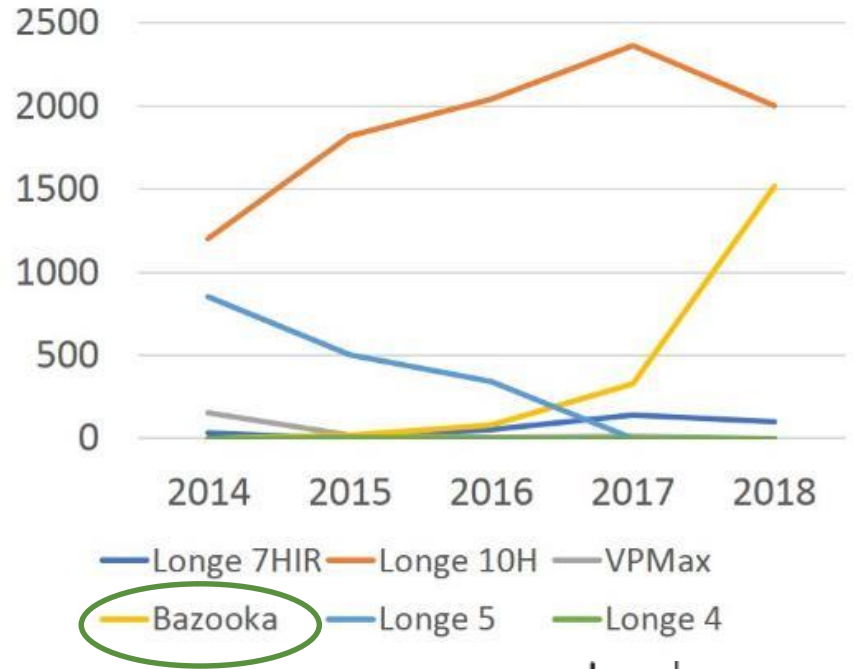


# Uganda



## Implementing Go-to-Market Strategy in Partnership Example: DT + MLN Hybrid in Uganda

**Certified seed production (ton), variety replacement, 2014-2018**



District	Area ha
Oyam	63,166
Kiryandongo	55,744
Masindi	48,768
Apac	44,596
Kamuli	43,678
Bugiri	35,252
Namutumba	23,400
Buyende	21,437
Kole	19,390
Mubende	16,682
Iganga	15,765
Jinja	11,309
Kayunga	10,963
Namayingo	10,634
<b>Total</b>	<b>420,783</b>



# Stress Tolerant Maize for Africa

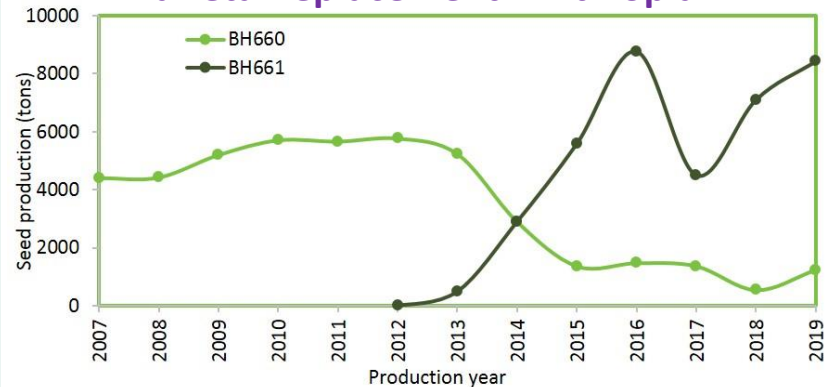
## Are we achieving scale and impacts?

- 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**

DT varieties certified seed production (ton) in UG and KE, 2014-2018



Varietal replacement in Ethiopia



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# 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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