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CIMMYT Eastern Africa Regional Office (Kenya)

Stephen Mugo

CIMMYT Regional Representative (CCR) for Africa

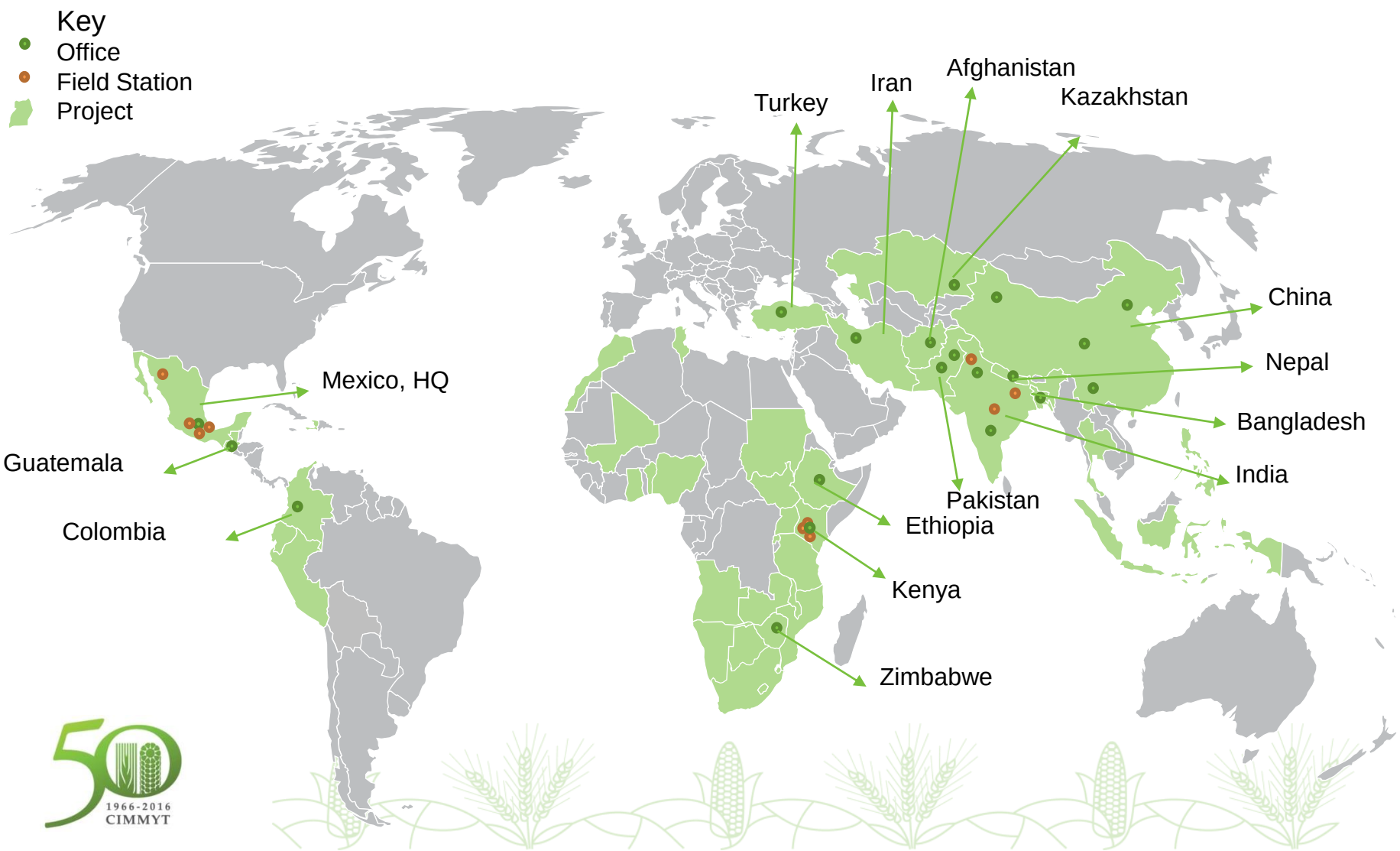
CIMMYT-Kenya

Presentation to NRF Kenya Visitors to CIMMYT Office, 5th Feb 2018

CIMMYT

International Maize and Wheat Improvement Center (CIMMYT)

1200 staff from over 50 countries!



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CIMMYT

CIMMYT

Through collaborative research, partnerships and training, CIMMYT works throughout the developing world to improve livelihoods and foster more productive, sustainable farming.

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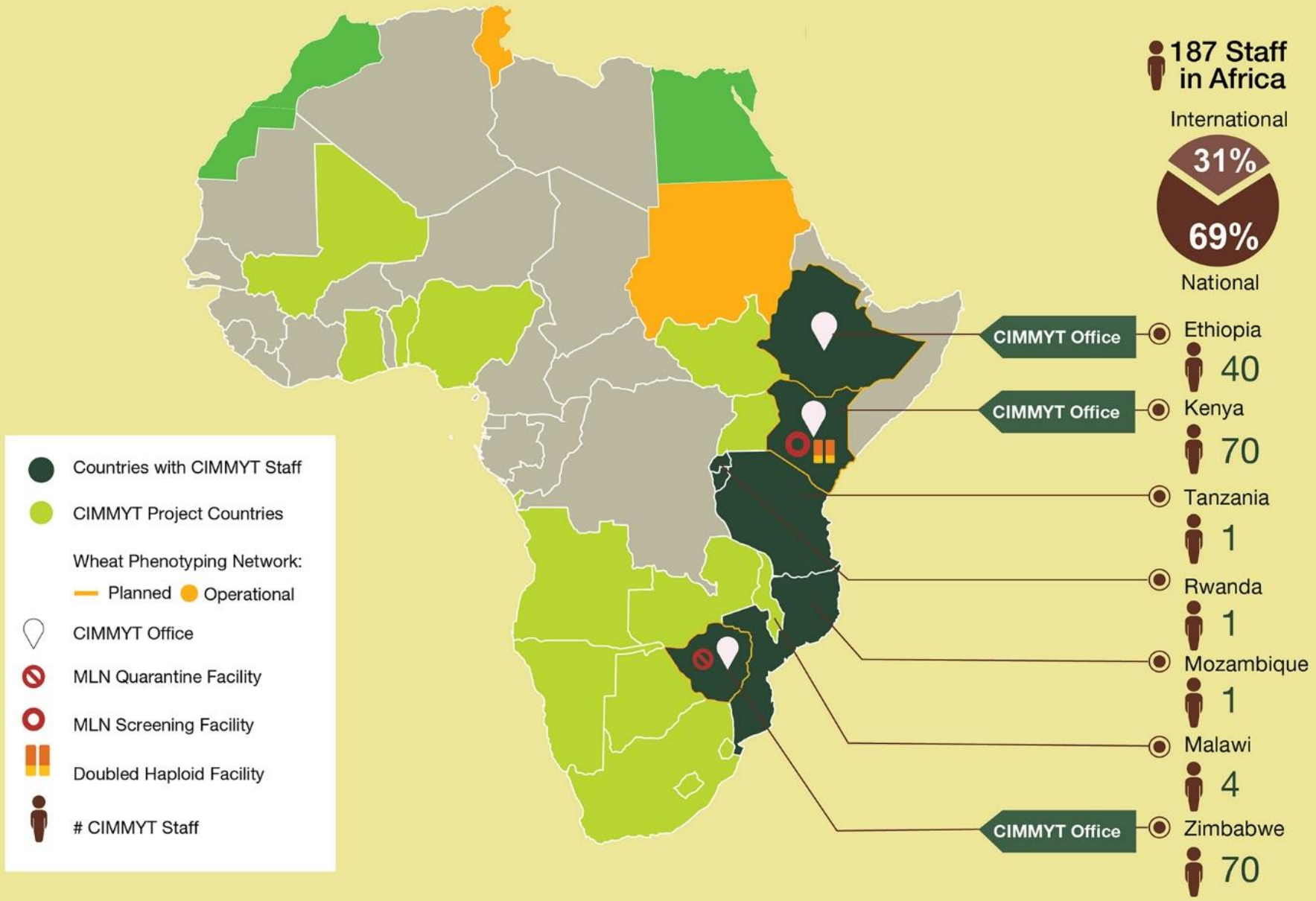
Major Achievements

Generate $3.5 – 4.5 billion in annual benefits to farmers in developing countries.

50% of maize and wheat grown in the developing world **based on CIMMYT varieties.**

10,000 researchers and professionals worldwide **alumni of CIMMYT training.**

CIMMYT in Africa



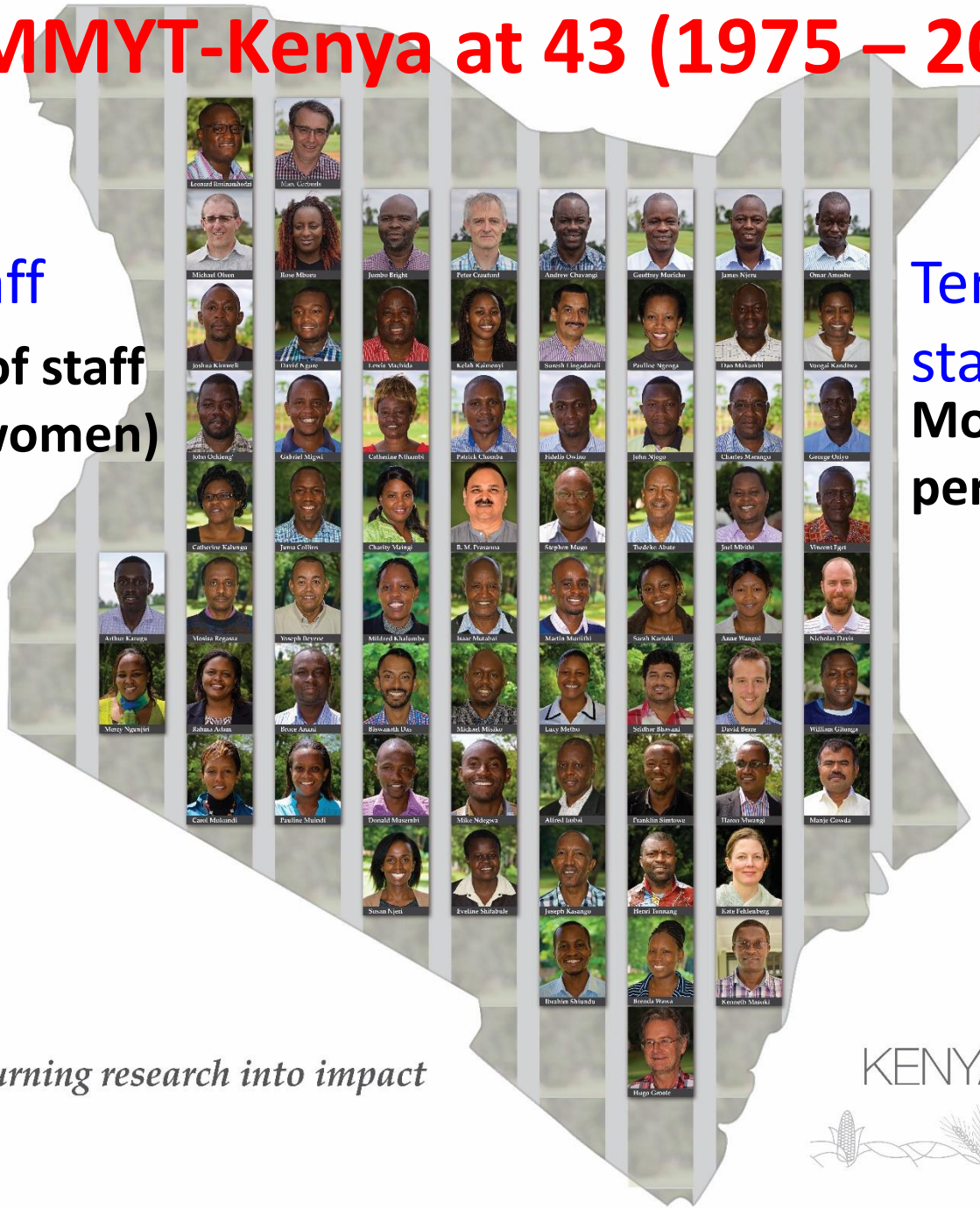
CIMMYT-Kenya at 43 (1975 – 2018)

Regular Staff

69 members of staff (50 Men/19 women)

Temporary field staff

More than 300 per month



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turning research into impact

KENYA STAFF 2016

History of CIMMYT-Kenya Office

Years	Main activity	No. IRS	Site
1975-1980	Office opened, Farming systems (Agricultural economics), Training	1-2	Lavington Green area
1981-1990	Maize and Wheat International trials testing, Farming systems, Wheat pathology, GLS in maize, Training, Biennial conference.	3-5	ILRAD Campus
1991-2000	Breeding for drought and low-N tolerance (AMS Project), *Striga* Control, MSV control, CMRT agronomy training, maize database project, IRMA project, Regional and International trials testing, Training	5-7	ILRI up to 1998 / ICRAF Campus

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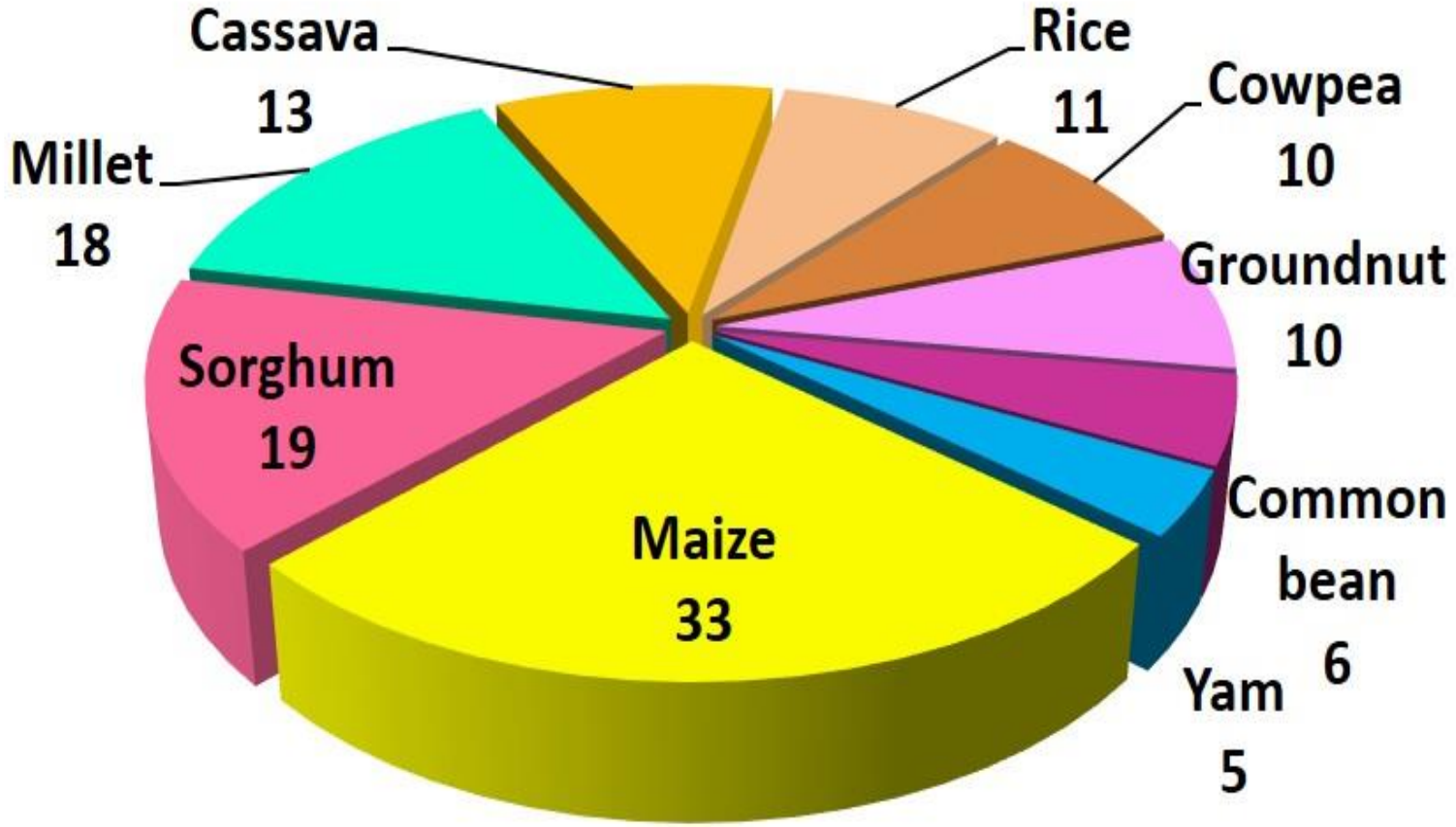
History of CIMMYT-Kenya Office

Years	Main activity	No. IRS	Site
2001–2010	Breeding for drought and low-N tolerance (DTMA & IMAS Project), Transgenic projects (IRMA, WEMA), *Striga* Control, IRMA project, Regional trials testing, seed systems unit, Training	7-20	ICRAF Campus
2011-2018	MLN management, FAW Management, Breeding for drought and low-N tolerance (DTMA Project), Transgenic projects (IRMA, WEMA projects), DH technology, MAB approaches, *Striga* Control, Regional trials testing, ROFVT, Training	20-30	ICRAF Campus

Major Staples of Africa

(Million Ha – FAO 2011 Data)



Where is wheat?

Africa spends its limited resources to import wheat

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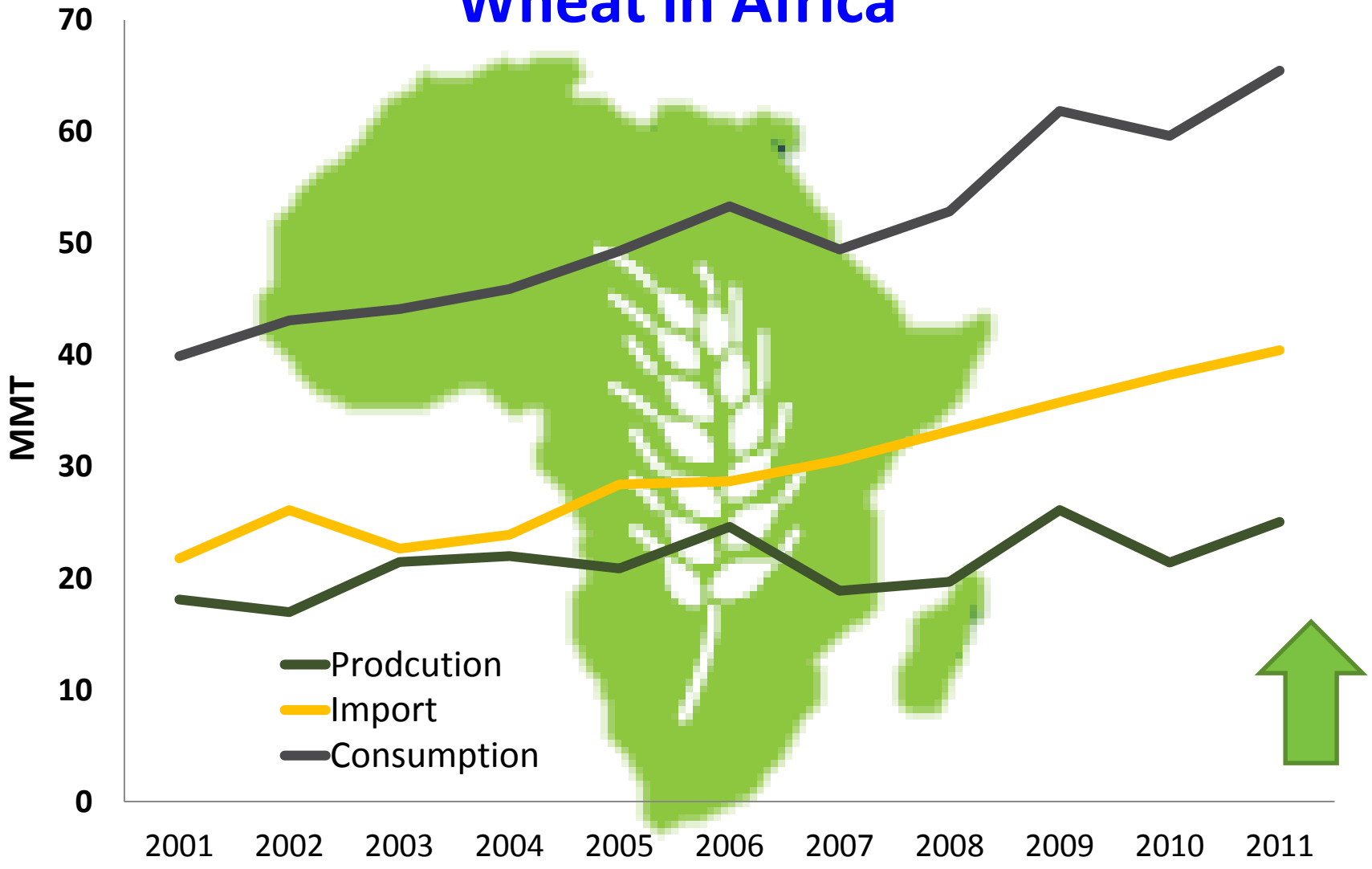
Wheat in Africa



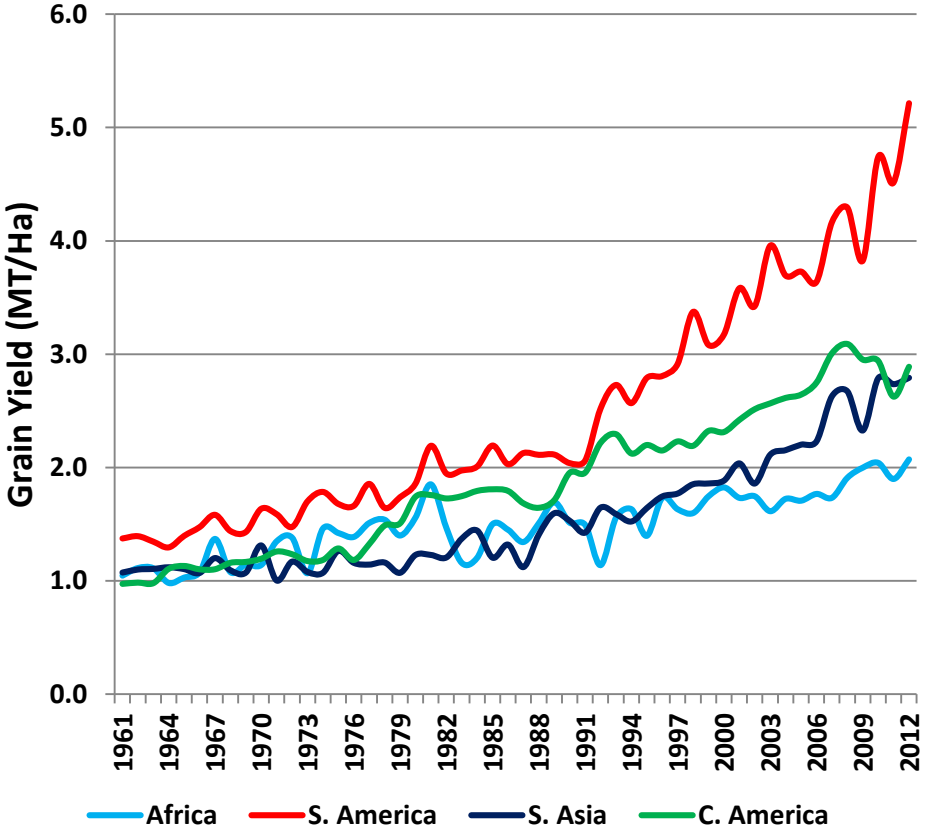
Wheat Ug99 Resistant Screening

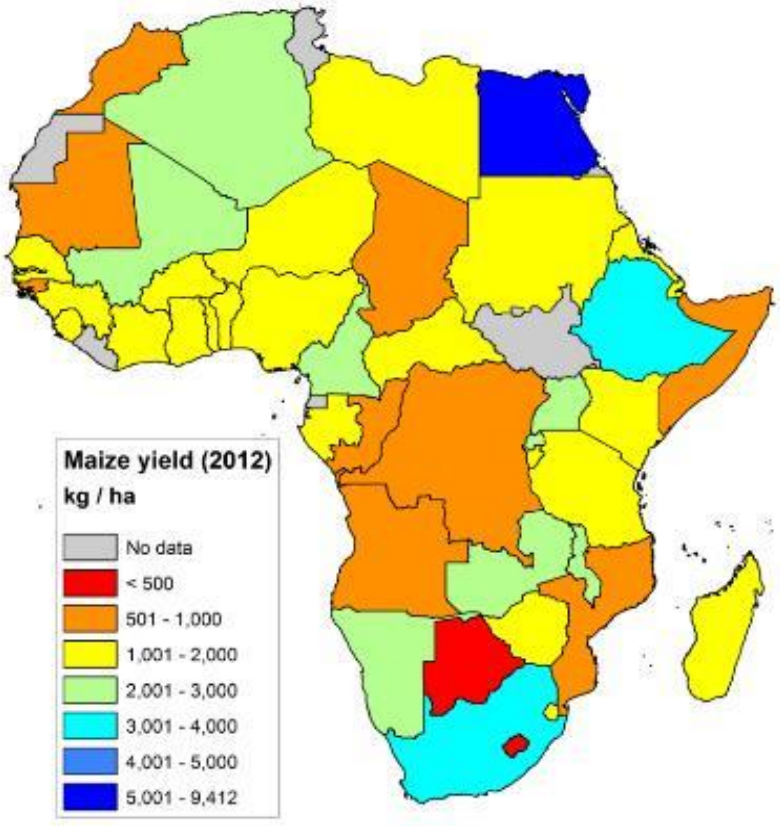
- Nearly 65 Ug99 resistant varieties released globally
- Capacity development- Annual stem rust training courses
- KALRO team was awarded the 2015 BGRI Gene Stewardship Award
- KALRO team received the coveted “Norman Borlaug” statue for their work in wheat during the 2015 Borlaug Global Rust Initiative (BGRI) Technical Workshop in Sydney, Australia

Maize provides food and income to several million people in the developing world

- **184 million hectares** worldwide; production **1016 MMT**
- >160 countries grow maize**; ~125 of these in developing world**
- **300 million metric tons** of maize produced on **90 million hectares** across the developing world (SSA, Latin America, Asia).
- Cropping systems and smallholder farmers worldwide depend on maize due to its multi-faceted uses (food, feed, fodder).

Maize grain yields in Africa have improved, but still far from optimal…





Average maize yield in SSA is yet to touch 2 t/ha; world average is 4.92 t/ha

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Maize and Wheat Production in Eastern Africa (2013)

Country	Production (Tons)		Productivity (t/Ha)		Area Harvested (Ha)	
	Maize	Wheat	Maize	Wheat	Maize	Wheat
Ethiopia	7,234,955	4,231,589	**3.42**	**2.54**	2,114,876	1,663,845
Kenya	3,513,171	328,637	1.66	**2.23**	2,116,141	147,210
Burundi	127,829	5,628	1.32	0.58	97,242	9,766
Rwanda	480,000	67,730	1.92	**2.19**	250,000	30,990
Tanzania	6,737,197	167,000	1.60	0.97	4,200,000	171,380
Uganda	2,763,000	22,000	**2.50**	1.57	1,105,000	14,000

This situation has to change and its changing

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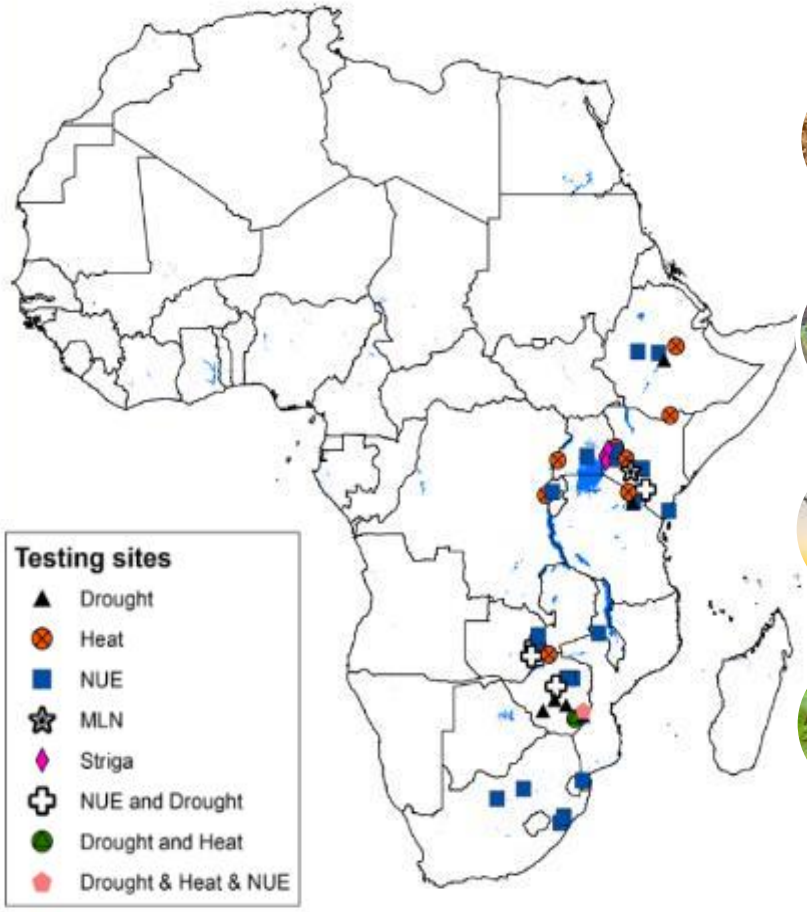
CIMMYT's Strong Maize Breeding product pipeline

Major traits*	Focus Regions
Drought tolerance	**SSA**; Asia; Latin America (LA)
Nitrogen use efficiency (NUE)	**SSA**; LA; China
Heat / Drought + Heat tolerance	**SSA**; Asia; LA
Acidity / Al toxicity tolerance	Latin America
Waterlogging tolerance	Asia
DT + Waterlogging tolerance	Asia
MLN resistance	**SSA**
Striga resistance	**SSA**
Aflatoxin resistance	**SSA**
Insect-pest resistance [Stem borers; Post-harvest (maize weevil and LGB) and fall armyworm (FAW)]	**SSA**
Quality traits (QPM, Pro-vitamin A, Kernel Zn, etc.)	LA, **SSA** and Asia

***Note**: Resistance to major diseases, such as MSV, GLS, TLB, Tar spot, ear rots, downy mildew etc., are integral part of product development strategies, based on regional importance.

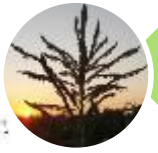
Perhaps the strongest managed stress screening network in sub-Saharan Africa



Drought* - 61 ha

*Including 12 ha DT CFT sites

Low nitrogen - 48.5 ha



Heat - 13.5 ha

MLN - 17 ha

+ One biosafety greenhouse complex and two functional insectaries

West Africa is served with similar facilities by IITA

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Maize and Wheat Production in Eastern and Central Africa Faces Challenges

- Yield potential
- Low soil fertility stress
- Drought stress
- Foliar and ear diseases (+ emerging)
- Stemborers, weevils and grain borers
- Non–optimal crop management practices
- Less than optimal seed systems to reach smallholder farmers
- Less than optimal nutritional content of current maize and wheat varieties

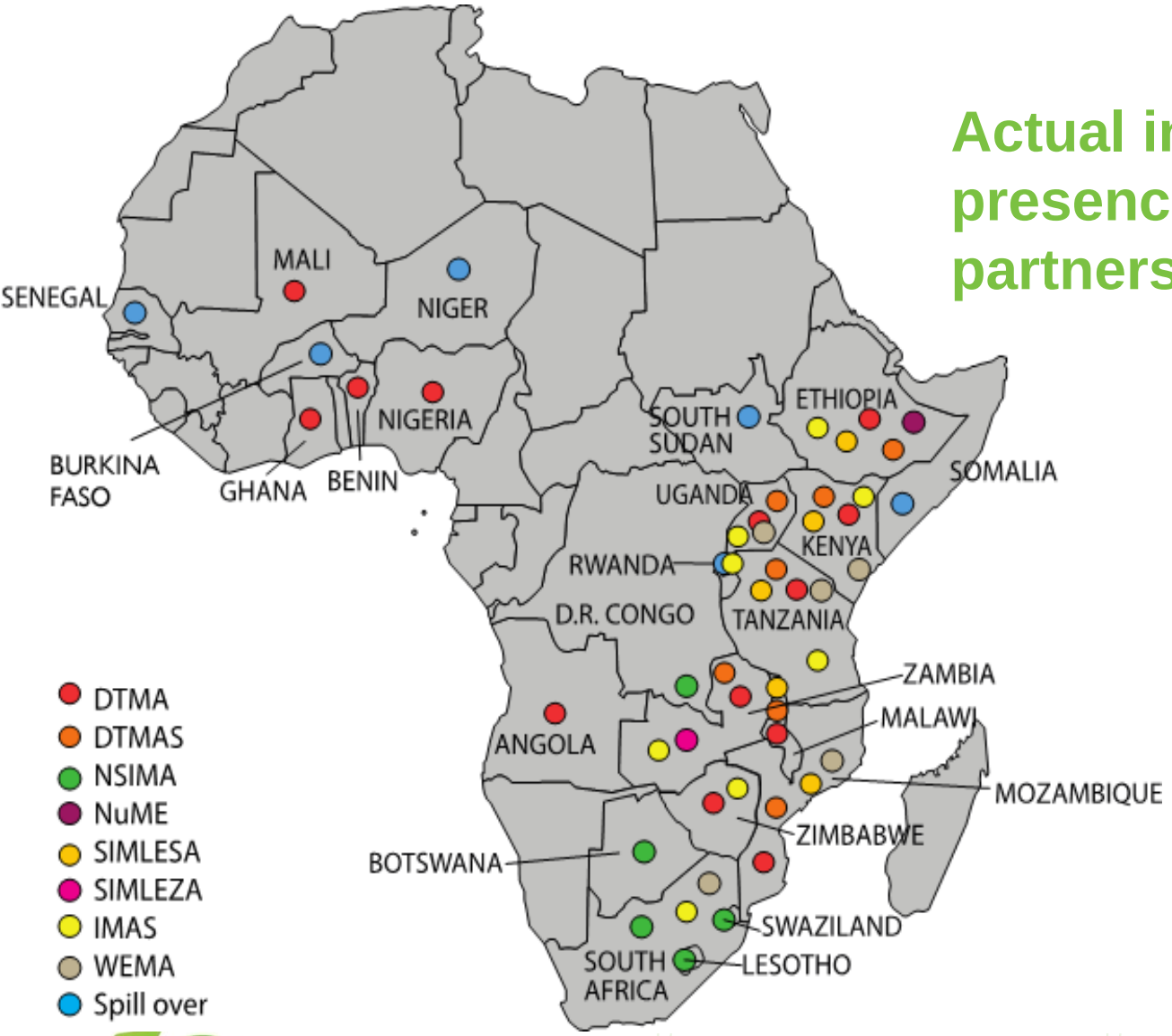
Considering CIMMYT's Mission:
Maize and wheat for improved livelihoods
We address these constraints through projects

Maize Projects at CIMMYT-Kenya

- Stress Tolerant Maize for Africa (STMA)
- Improved Maize for African Soils (IMAS)
- Taking Maize Agronomy to Scale in Africa (TAMASA)
- Drought Tolerant Maize for Africa Seed Scaling (DTMASS)
- Water Efficient Maize for Africa (WEMA)
- Managing and Understanding Maize Lethal Necrosis
- Doubled Haploid facility for strengthening maize breeding programs in Africa
- Fall armyworm Management

Breeding for drought tolerance at CIMMYT is four decades old…

CIMMYT-Africa Maize Projects have Huge Impact



Actual influence and presence due to effective partnerships built in SSA

Spill-overs also in Asia

Afghanistan
Bangladesh
Bhutan
China
India
Indonesia
Nepal
Philippines

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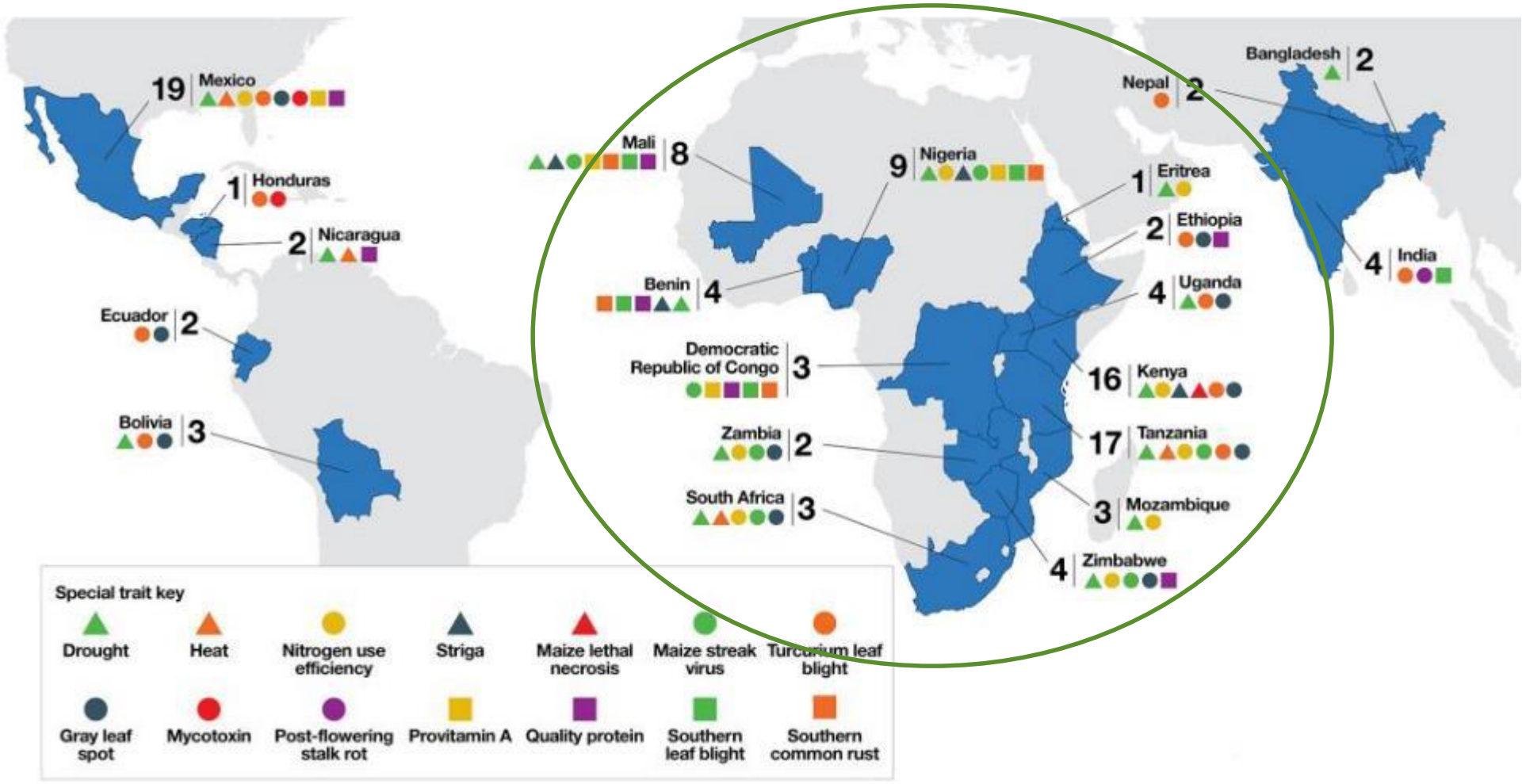
MAIZE Varietal Releases in 2016



2016: 111 (LA – 27; ESA – 52; WCA – 24; Asia – 8)

+ including **11 Provitamin A-enriched varieties** (3 in DRC; 7 in Mali; 1 in Nigeria)

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CoA 3.1 & 3.3

Drought Tolerant (DT) Maize in Africa: A Success Story

- **>300 Improved DT maize varieties released in countries across Africa – a significant first step!**
- **From <6,000 tons in 2007 to >70,000 tons** of certified maize seed produced and delivered in 2016 by partners across SSA
- From **16 companies in 1990s to >100 seed companies** engaged in producing and commercializing DT maize varieties

Introducing Novel Genetic Variation

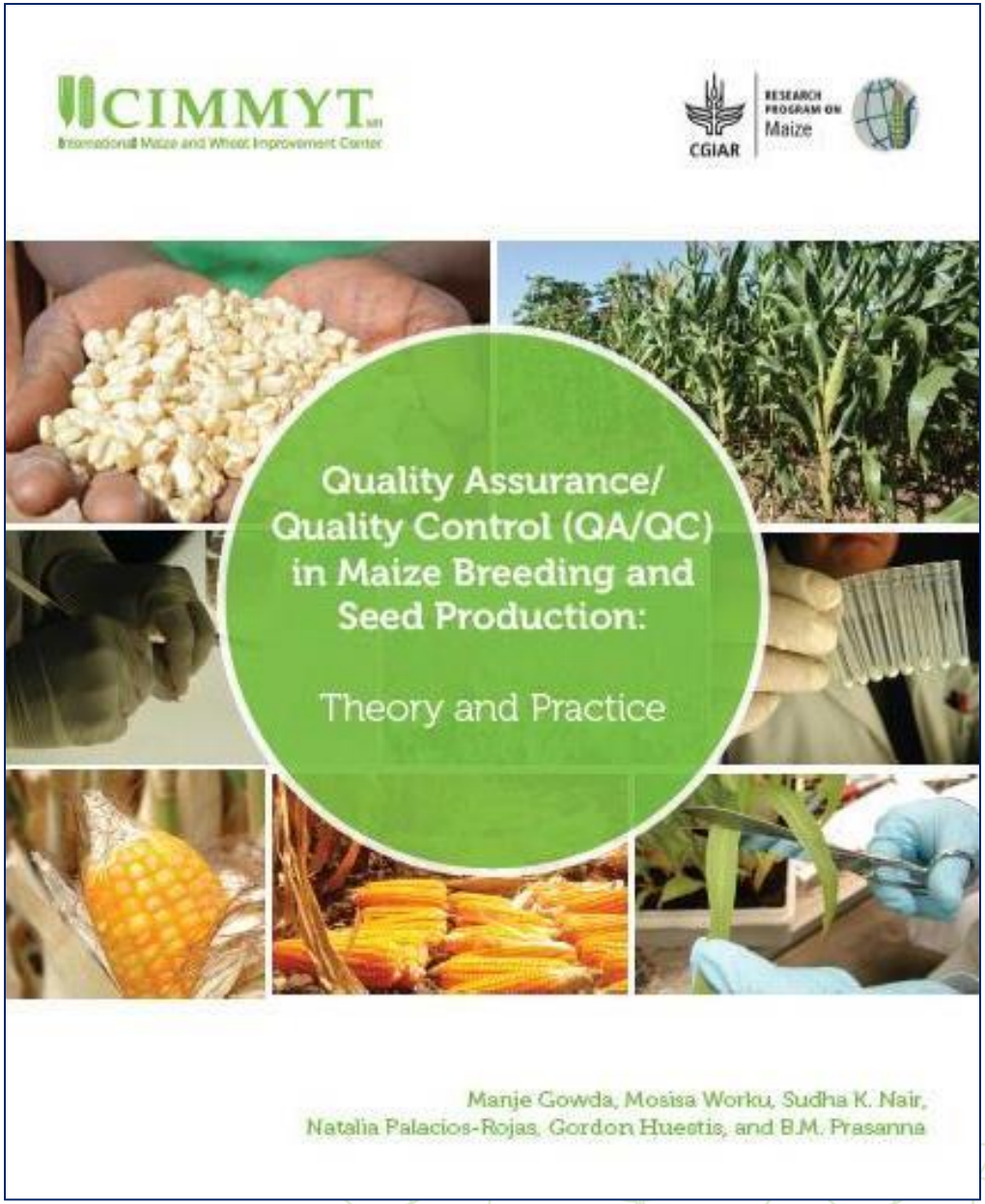
Temperate-tropical introgression

- High yield potential
- High density tolerance
- Resource use efficiency

Intensive work on tropical-temperate introgressions at CIMMYT maize breeding hubs in Zimbabwe, Mexico, India and China

Molecular marker assisted strategies to accelerate gain from adapted x exotic populations

Quality Assurance/Quality Control



- QA/QC protocols need to be rigorously implemented throughout the seed value chain
- **Genetic purity** and **genetic identity** of the materials under production

Driving Genetic Gains

- Increasing the size of the breeding program - greater selection intensity
- Faster breeding cycles (DH, markers, RCGS)
- More accurate selection (higher heritability)
- Infusing new and useful genetic variation
- Decision support tools

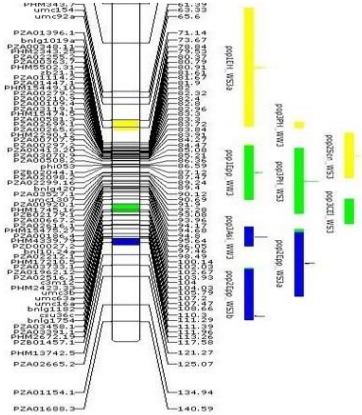
Maize Doubled Haploid (DH) Facility at KALRO-Kiboko, Kenya

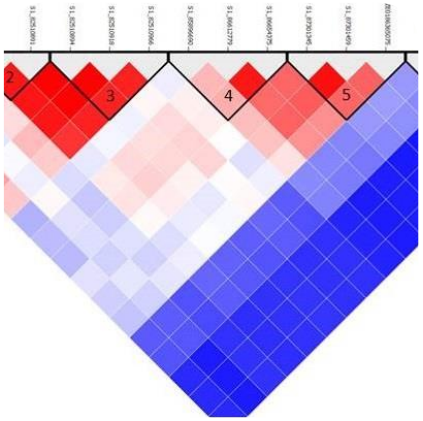
Offering DH development service as centralized platform to NARS and SME seed company partners → economy of scale!

The facility is producing annually >60,000 DH lines from **diverse source populations**

CIMMYT DH Facility in Agua Fria/Maztitlan produces ~15,000 DH lines each year.

Production Markers for High Value Traits





Discovery

- Heat
- *Striga*

Validation

- TSC
- GLS
- TLB
- Aflatoxin
- Drought
- NUE
- Soil acidity

Deployment

- Provitamin A
- MSV
- MLN
- Haploid Induction Rate

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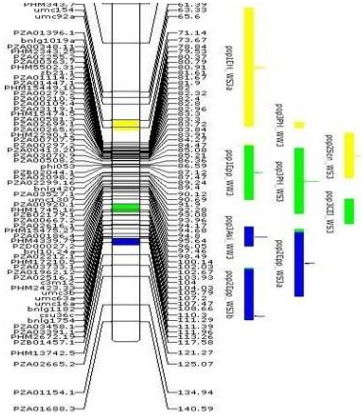
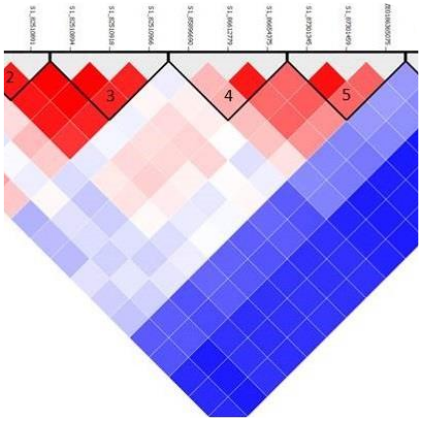
Production Markers for High Value Traits





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Deployment

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- Haploid Induction Rate

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Protecting Genetic Gains from Devastating Epidemics

Maize Lethal Necrosis (MLN) is a viral disease caused by combined infection of maize with Maize Chlorotic Mottle Virus (MCMV) and any of the Potyviruses infecting cereals, especially Sugarcane Mosaic Virus (SCMV)

The disease was first reported in Africa, particularly in Kenya in Sept 2011, and since then reported in Uganda, Tanzania, Rwanda, D.R. Congo, and Ethiopia.

MLN Screening Facility at Naivasha, Kenya

~125,000 germplasm entries (>200,000 rows) screened against MLN under artificial inoculation at the Naivasha facility, since Sept 2013. Of these, **61% were from CIMMYT, 18% were from NARS, and 21% were from the private sector**.

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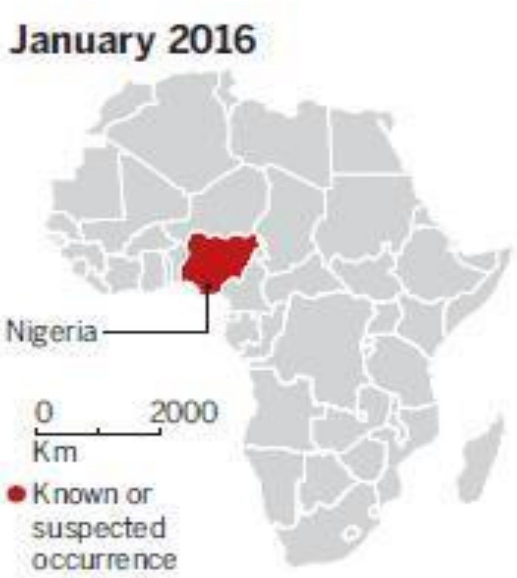
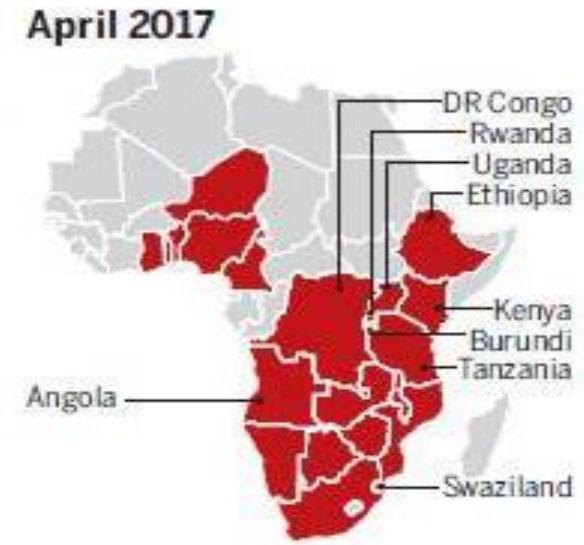
Fall Armyworm (*Spodoptera frugiperda)*

A new threat in Africa

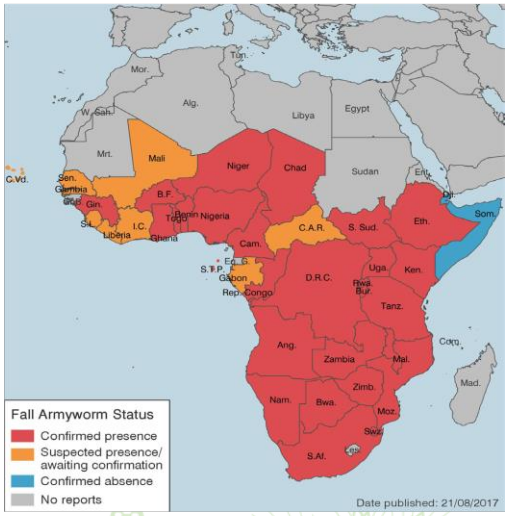
Rapid Spread of Fall Armyworm in Africa



May 2017

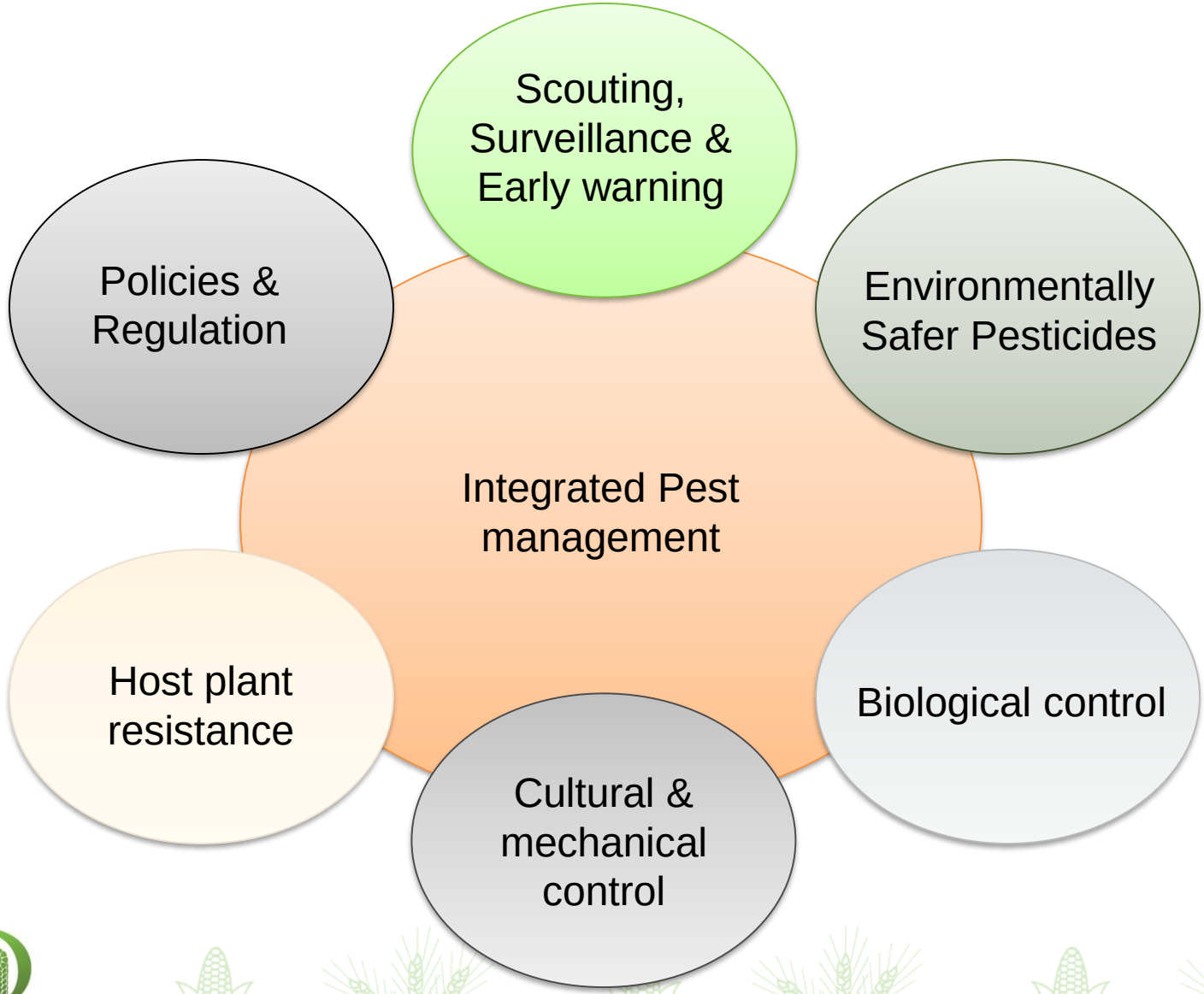


Sept 2017



Source: Erik Stokstad, Science, 5th May, 2017

FAW management approaches in Africa: no silver bullet!



Screening of maize lines under FAW natural infestation at Kiboko (2017)

CML444 (Susceptible)

CKDHL164288 (Putative Resistant)

CKDHL164282 (Susceptible)

CKDHL166062 (Putative Resistant) developed from MBR population

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How does CIMMYT's IMPROVED MAIZE get to the farmer?

CIMMYT
International Maize and Wheat Improvement Center

1 PRODUCT DEVELOPMENT

Feedback to inform breeding targets.

Breeding funnel
Stage 1
Stage 2
Stage 3

CIMMYT breeders advance the most promising hybrid combinations from one stage to the next.

Assessment of farmer preferences and preferred traits.

CIMMYT organizes field days with partners

Regional on-station trials

Regional on-farm trials

Product Advancement Meetings

2 PRODUCT ALLOCATION

Partners request products

CIMMYT announces best new products

CIMMYT reviews partner applications

Sign registration & commercialization agreements

3 RELEASE & COMMERCIALIZATION

Partners sponsor products in National Performance Trials

National authorities release & register succesful varieties from NPTs

Partners produce & sell seed

CIMMYT supports partners with technical backstopping, early generation seed supply, and business management advice

Farmers adopt & benefit from improved maize seed

Feedback from partners and impact assessment.

Training the next generation Maize and wheat Scientists

- Formal training
  - BSc – Industrial attachment
  - MSc/PhD- Field / lab research
  - Regular courses
    - Biennial new breeders course – Maize
    - Annual Wheat breeders courses
    - Biennial Senior breeders course
- Informal training
  - Technical back stopping
  - Visiting scientist – hands on training
- **CIMMYT Academy**
- **10,000** researchers and professionals worldwide **alumni of CIMMYT training.**
- **Excellence in Breeding (EiB) CGIAR Platform**

CIMMYT Achievements in Africa

USD 37 million

Yearly investment of CIMMYT's projects in Africa

CIMMYT-Africa maize breeding hubs in Ethiopia, Kenya and Zimbabwe help in exchanging huge amounts of maize germplasm across the world

650,000 farmers

in eastern and southern Africa will be supported to adopt sustainable intensification practices, (by 2023) improving productivity by at least 30 percent

Rapid response to tackle **maize lethal necrosis (MLN)** epidemic in eastern Africa It has led to the release of MLN-tolerant varieties in Kenya, Tanzania and Uganda

In 2014, 52,000 tons

of certified drought tolerant varieties were produced under the Drought Tolerant Maize for Africa project

enough for

2 million hectares

benefiting

5.2 million households

in sub-Saharan Africa

Over **200 improved drought tolerant maize varieties** were released under the Drought Tolerant Maize for Africa project through over 140 national seed companies in 14 countries between 2007 and 2015

Quality Protein Maize

Helping smallholders fight malnutrition in rural households in Benin, Ethiopia, Ghana, Kenya, Nigeria, South Africa, Tanzania, Uganda, Zambia and Zimbabwe

210 African students

graduated from higher education after receiving sponsorship from CIMMYT between 2005 and 2014

Ug99 Wheat Rust Disease (the biggest threat to wheat)

Eastern Africa is at the center of CIMMYT's efforts to control the disease. It was first detected on CIMMYT nurseries in Uganda and now present in 13 African countries

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