Winning the Fight against Maize Lethal Necrosis Disease (MLN)

Stephen Mugo[1], B.M. Prasanna, L.M. Suresh and F. Mwatuni

[1]CIMMYT Regional Representative (CRR) for Africa
s.mugo@cgiar.org

Media for Environment, Science, Health and Agriculture (MESHA), African Conference of Science Journalists III, Science Journalism for Progress and Sustainability in Africa, Dec. 13-15, 2018, Ngong Hills Hotel, Nairobi

CIMMYT

International Maize and Wheat Improvement Center (CIMMYT)

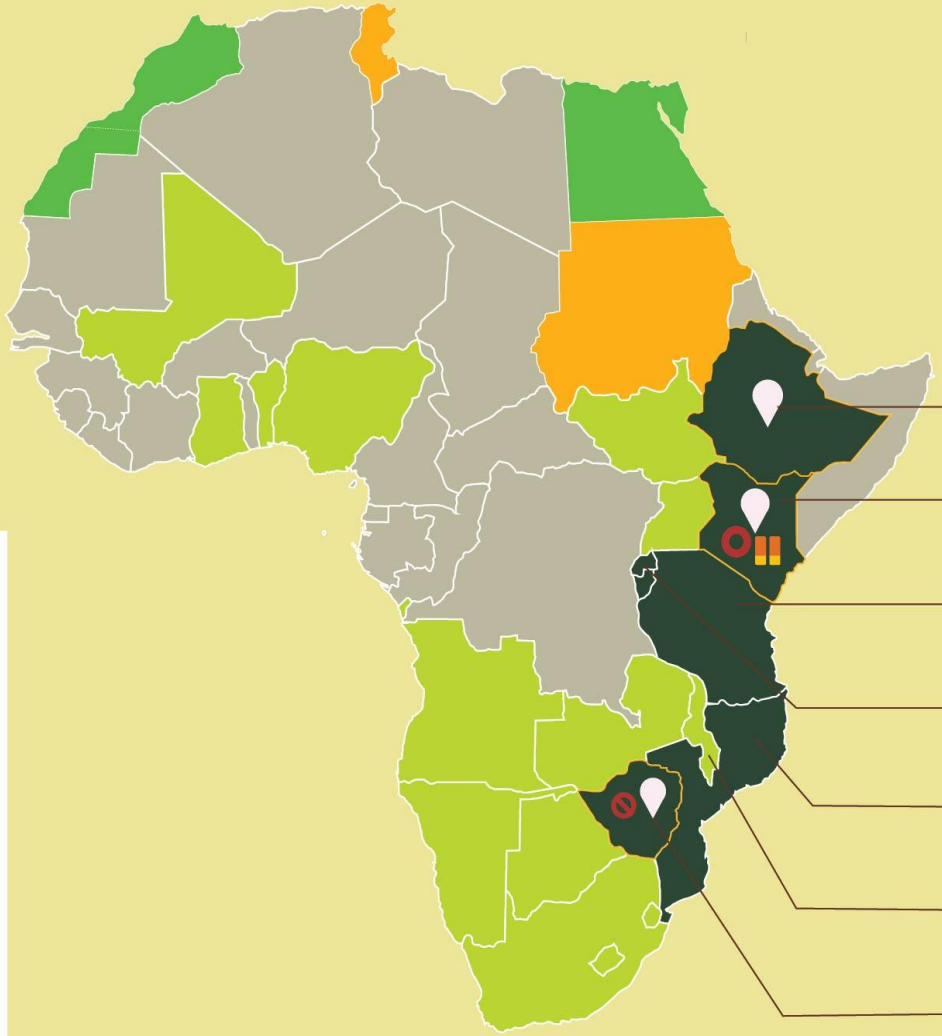
1200 staff from over 50 countries!

CIMMYT MR

CIMMYT

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

CIMMYT in AFRICA



187 Staff in Africa

International 31%

National 69%

- Ethiopia — CIMMYT Office — 40
- Kenya — CIMMYT Office — 70
- Tanzania — 1
- Rwanda — 1
- Mozambique — 1
- Malawi — 4
- Zimbabwe — CIMMYT Office — 70

Countries with CIMMYT Staff

CIMMYT Project Countries

Wheat Phenotyping Network:

Planned Operational

CIMMYT Office

MLN Quarantine Facility

MLN Screening Facility

Doubled Haploid Facility

CIMMYT Staff

What is Maize Lethal Necrosis (MLN)?

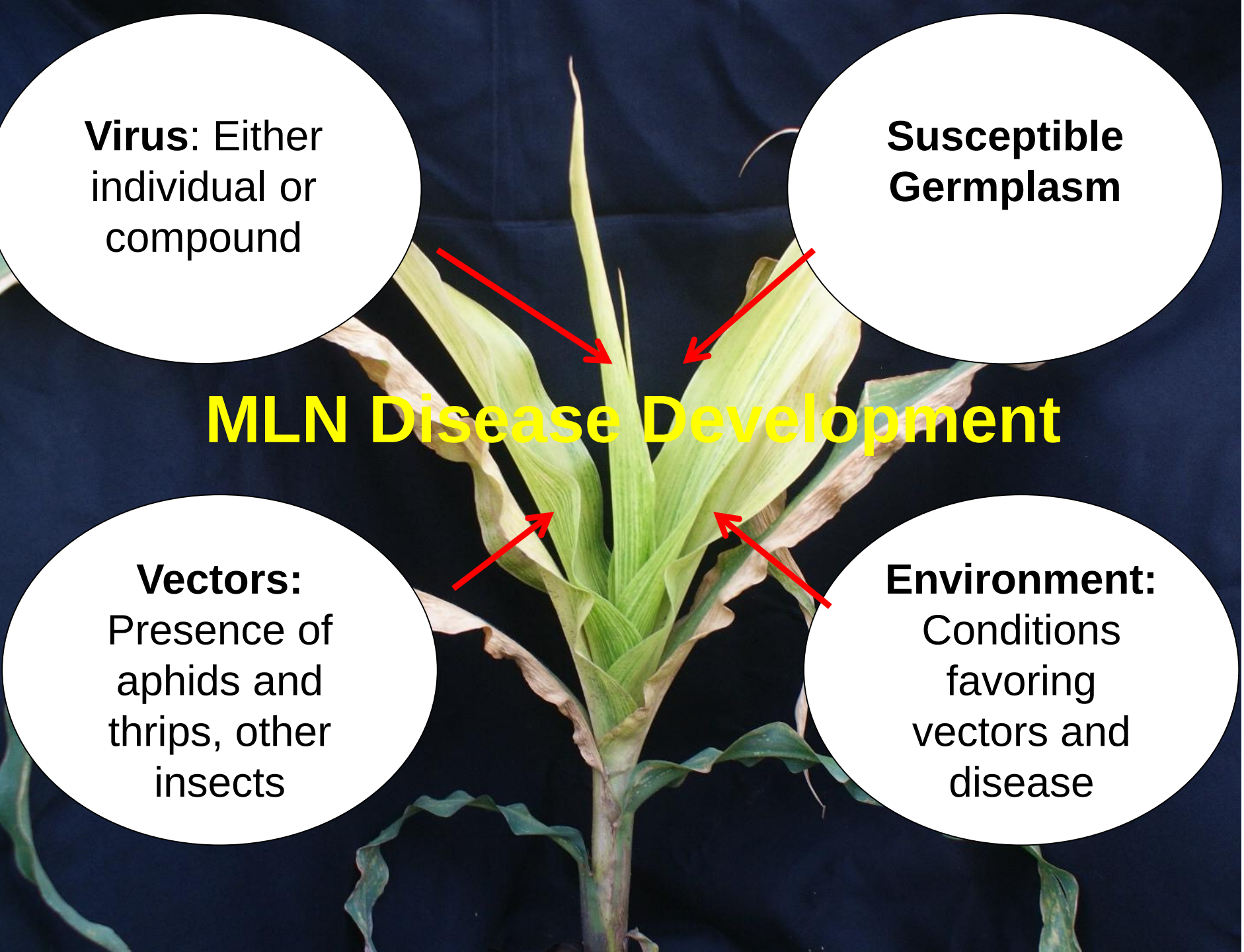
MCMV + **Potyvirus**
SCMV
MDMV
WSMV
= **MLN**

- **Individual infection with each virus can also cause disease**
- Typically, infection with one virus results in milder symptoms than MLN but reaction depends on germplasm and viral strain.

CIMMYT

MLN threatens Food Security and increases poverty

CIMMYT


Virus: Either individual or compound
Susceptible Germplasm
MLN Disease Development
Vectors: Presence of aphids and thrips, other insects
Environment: Conditions favoring vectors and disease

MLN Symptoms

CIMMYT MR

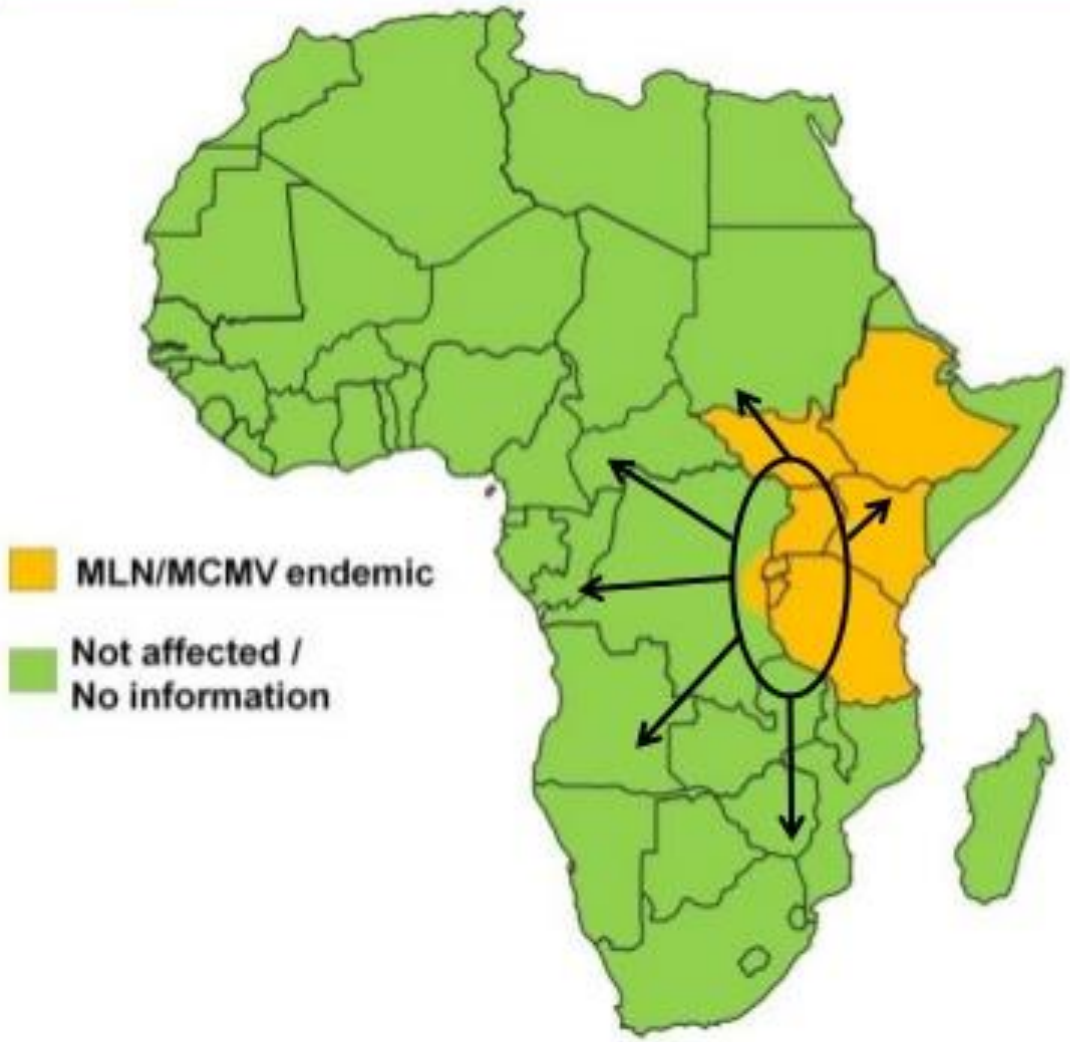
MLN in a Hybrid Seed Production Field in Tanzania

Distribution of MCMV and MLN

Maize lethal necrosis has occurred fairly rarely and sporadically around the world over the past 40 years.

Source: Dr. Peg Redinbaugh - OSU

MCMV Spread in Africa



Distribution in Africa

- Kenya (2012)
- Tanzania (2013)
- Uganda (2013)
- Rwanda (2013)
- Burundi (2013)
- South Sudan (2013)
- DRC (2014)
- Ethiopia (2014)

Damage and loss of Maize to MLN

- MLND destroys whole fields of maize
  - Stunting
  - Outright death of plants
  - Little or no grain production

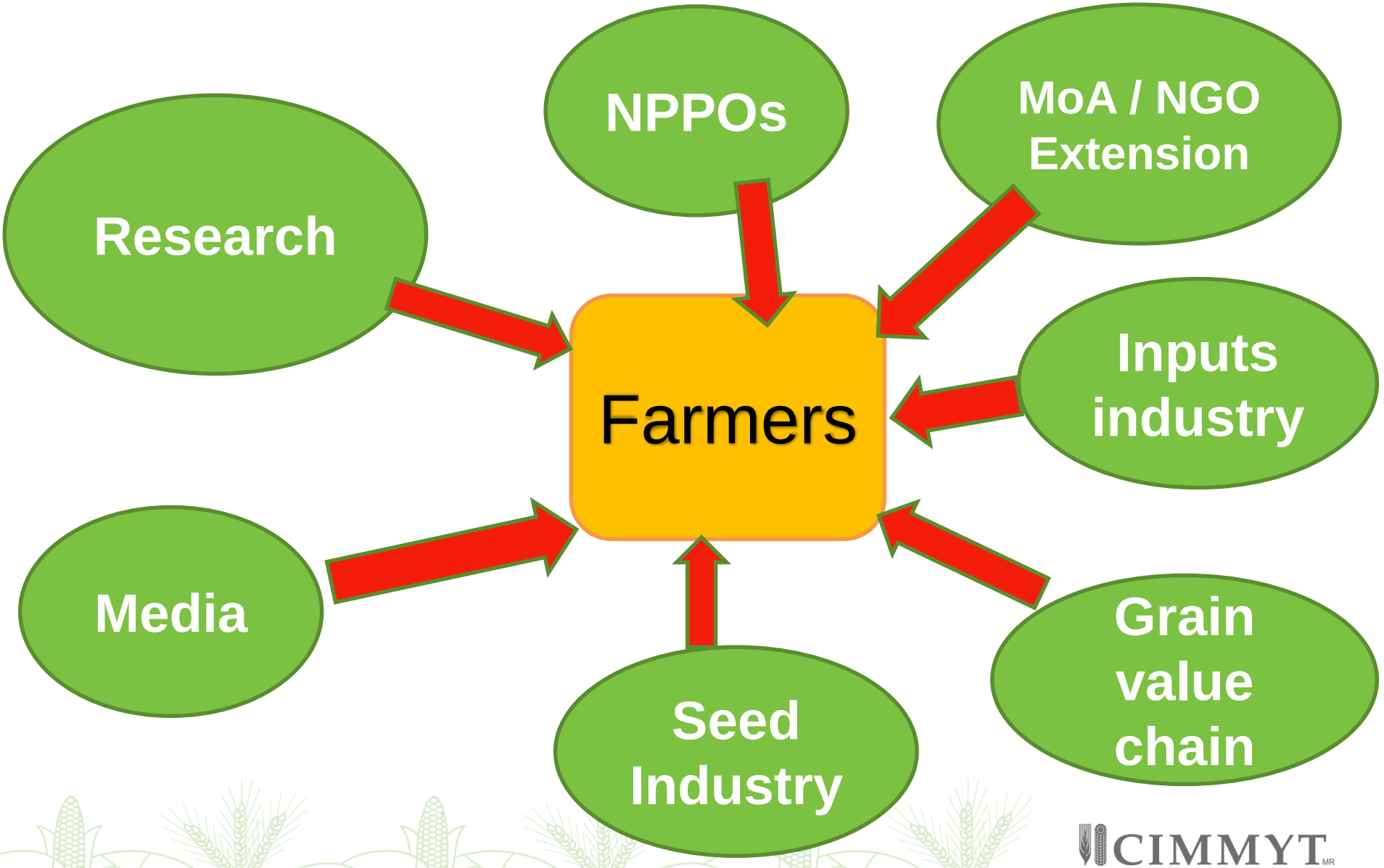
Makes MLN a devastating disease

Kenya – 28.5%

EA region – 27.5%

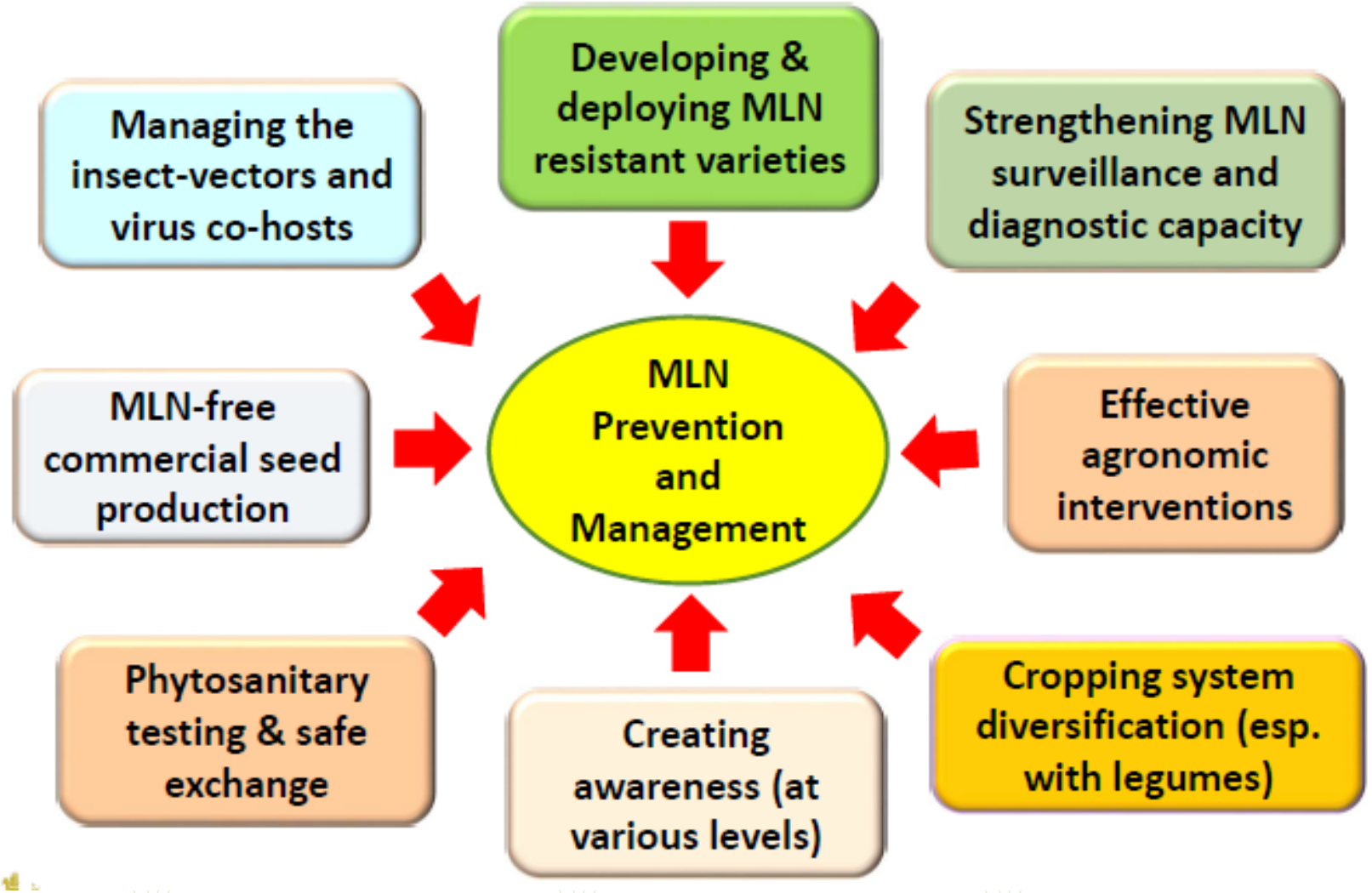
CIMMYT

MLN Stakeholders



CIMMYT

Tackling the MLN challenge



CIMMYT

Accelerated Breeding for MLN Resistance

KALRO-CIMMYT MLN Screening Facility at Naivasha (Kenya)

- > **122,000 diverse germplasm entries (206,000 rows)** screened against MLN under artificial inoculation at the Naivasha facility since Sept 2013.
- Of these, **61% from CIMMYT, 18% from NARS, and 21% from the private sector**.

CIMMYT


CIMMYTs MLN-resistant hybrid
Commercial check

MLN Tolerant Hybrids released in EA

No	MLN-tol Hybrid	Year of Release	Country	Status
1	Bazooka UH5354	2014	Uganda	Being commercialized by NASECO
2	H12ML	2013	Kenya	Seed produced by KSC
3	H13ML	2014	Kenya	Being commercialized by KSC.
4	Meru HB607	2014	Tanzania	Seed produced by Meru Agro in 2017
5	WE5135	2016	Kenya	Released through KALRO
6	WE5140	2016	Kenya	Released through KALRO
7	WE6109	2016	Kenya	Released through KALRO
8	WE6110	2016	Kenya	Released through KALRO
9	KATEH16-01	2017	Kenya	Licensed to Agri-seed by KALRO
10	KATEH16-02	2017	Kenya	Released through KALRO
11	KATEH16-03	2017	Kenya	Released through KALRO
12	WHMLN	2018	Kenya	To be released through WS Company
13	WE7117	2018	Kenya	To be released through KALRO
14	WE7118	2018	Kenya	To be released through KALRO
15	WE7119	2018	Kenya	To be released through KALRO

On-farm Demos of DT + MLN-tolerant hybrid Bazooka, in Uganda by NASECO

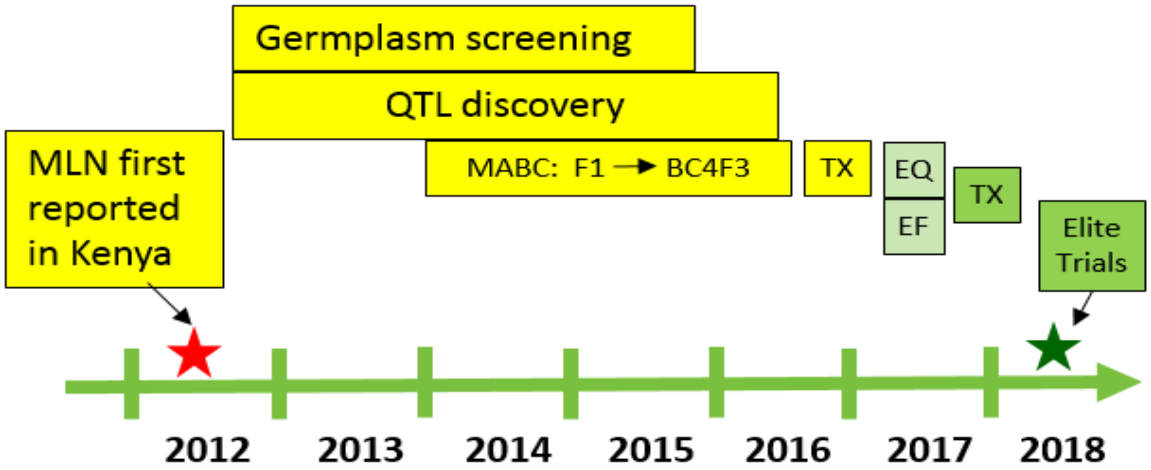
CIMMYT

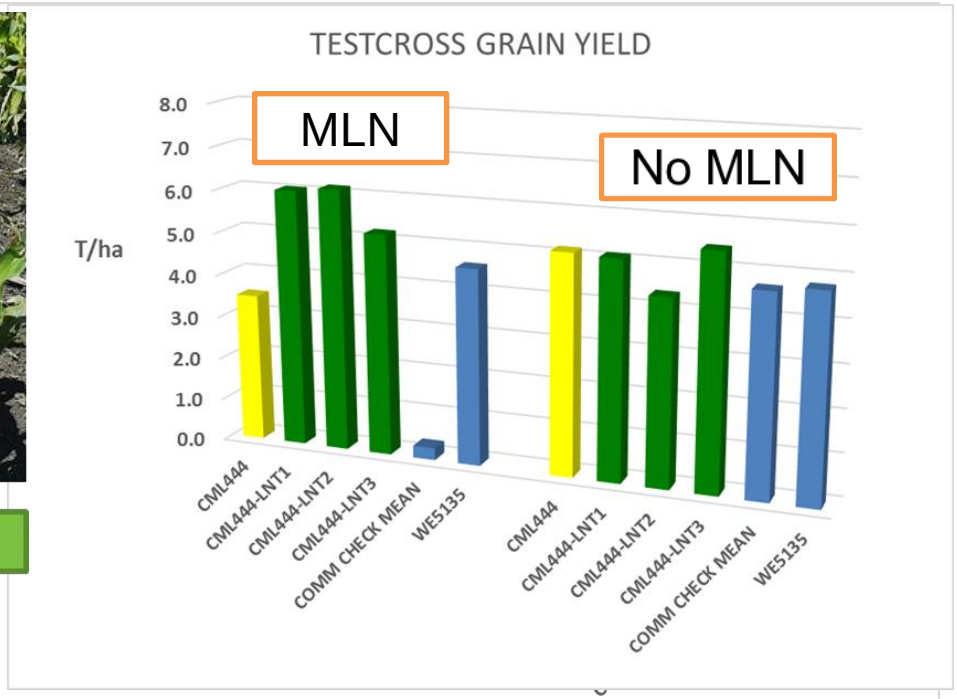
MLN Quarantine Facility at Mazowe, Harare

- Established with support from USAID, DR&SS-Zimbabwe, and CRP MAIZE.
- Enables CIMMYT maize germplasm flow from eastern Africa to southern Africa after evaluation under quarantine conditions

CIMMYT

Rapid Response to MLN





Toward Gene Editing: qMLN_06.157

ENTRY	126	126	127	130	130	qMLN	131	132		133	133	AVE MLN	MLN SCORES
KS23-6	C/C	A/A		A/A	G/G	R/R		A/A	G:G	C/C	C/C	4.0	4 4 4 3 3 4 3 | 4 4 4 4 4 4 4 4
CML548/KS23-6	C/C	A/A		A/A	G/G	R/R		A/A	G:G	C/C	C/C	3.0	3 3 3 3 4 4 3 3 4 3 | 4 4 4 3 3 3 4 4 3 3 4
CML548/KS23-6	C/C	A/A		A/A	G/G	R/R		A/A	G:G	C/C	C/C	4.0	4 4 4 4 4 3 3 3 4 | 4 3 3 5 4 4 4 3 3 4 3
CML548/KS23-6	C/C	A/A		A/A	G/G	R/R		A/A	G:G	C/C	C/C	4.0	4 4 3 5 5 3 4 4 4 | 3 4 3 3 3 3 3 4 5
CML548/KS23-6	C/C	A/C		A/A	G/G	R/R		A/A	-	C/C	C/C	4.0	4 4 4 4 4 3 4 4 4 4 4 | 4 4 4 4 4 4 4 4 5 5
CML548/KS23-6	C/C	A/C		A/A	G/G	R/R		A/A	G:G	C/C	C/C	4.0	6 5 5 4 4 4 4 3 4 3 3 4 | 4 4 4 4 4 5 4 4 4 4
CML548/KS23-6	C/C	A/A		A/A	G/G	R/R		A/G	G:A	C/T	C/T	3.8	3 3 3 4 4 4 4 4 3 4 | 3 4 4 4 4 4 4 4 4 4 4
CML548/KS23-6	C/C	A/A		A/A	G/G	R/R		A/G	G:A	C/T	C/T	4.0	4 3 4 3 3 4 3 5 3 | 4 5 4 4 4 4 4 4 6
CML548/KS23-6	C/C	A/A		A/C	G/T	R/S		A/G	G:A	C/T	C/T	6.0	4 3 5 3 5 8 6 4 7 | 6 6 7 4 3 4 9 9 9 8
CML548/KS23-6	C/C	C/C		A/C	G/T	R/S		A/G	G:A	C/T	C/T	5.0	6 4 6 7 4 6 4 6 7 7 6 | 4 5 3 4 4 4 6 7 3
CML548/KS23-6	C/C	C/C		C/C	T/T	S/S		G/G	G:A	C/T	C/T	7.0	6 6 6 5 8 4 9 9 6 | 7 7 8 9 7 8 5 4 9
CML548/KS23-6	C/C	C/C		C/C	T/T	S/S		G/G	A:A	T/T	T/T	7.9	6 9 5 9 8 9 9 8 6 5 9 | 9 7 9 8 8
CML548	C/G	C/C		C/C	T/T	S/S		G/G	A:A	T/T	T/T	7.0	9 5 5 5 5 6 | 9 9 9 7 9 9 5
KS23-6	C/C	A/A	G/G			R/R	A/A	A/A				4.0	4 4 5 4 4 4 | 4
CKDHL0221/KS23-6	C/C	A/A	G/G			R/R	A/A	A/A				3.0	3 3 3 3 3 4 3 3 4 3 | 3 4 3 4 4 3 3 4 5 4 4 4 4
CKDHL0221/KS23-6	C/C	A/A	G/G			R/S	A/G	A/G				6.0	4 4 8 8 4 8 8 8 6 7 | 4 8 4 4 7 4 4 8 7 4 4 4
CKDHL0221/KS23-6	C/C	A/A	A/G			R/S	A/G	A/G				7.0	9 9 8 9 9 7 4 9 9 9 | 8 4 8 4 7 5 9 8 4 9
CKDHL0221/KS23-6	C/G	A/C	A/G			R/S	A/G	G/G				7.0	9 7 | 7 6 9 4 4 9
CKDHL0221/KS23-6	C/G	A/C	A/G			R/S	A/G	G/G				7.0	5 3 9 8 9 4 9 | 8 7 8 9 3 9 5
CKDHL0221/KS23-6	C/G	A/C	A/G			R/S	A/G	A/G				7.0	8 5 6 7 5 9 9 5 | 6 7 8 7 8 9 9 4 9 9 9 9
CKDHL0221/KS23-6	G/G	A/C	A/G			S/S	G/G	A/G				9.0	9 9 9 9 9 9 9 | 9 5 9 9 9 9 9
CKDHL0221/KS23-6	G/G	C/C	A/A			S/S	G/G	G/G				9.0	8 8 7 9 | 9 9 9 9 9 9 9 9
CKDHL0221	G/G	C/C	A/A			S/S	G/G	G/G				8.0	9 6 9 9 | 5 4 9 9 9 9

qMLN_06.157 localized to ~125 kb interval

Mark Jung
Alyssa DeLeon
Kevin Simcox
Kanwarpal Dhugga

CORTEVA™ agriscience

CIMMYT MR

MLN Diagnostics and Management

1. Prevent the spread of MLN, especially Maize Chlorotic Mottle Virus (MCMV), from the MLN-endemic countries in eastern Africa to non-endemic countries in sub-Saharan Africa;
2. Support the commercial seed sector in the MLN-endemic countries in producing MCMV-free commercial seed and promote the use of clean hybrid seed by the farmers and
3. Establish a MLN Phytosanitary Community of Practice in Africa, for sharing of learning, MLN diagnostic and surveillance protocols, and best management practices for MLN control in Africa.

- Training surveillance teams and MLN surveys and sampling in countries

- Check list
- Tools and materials
- Training

- Regular meetings
- Info sharing

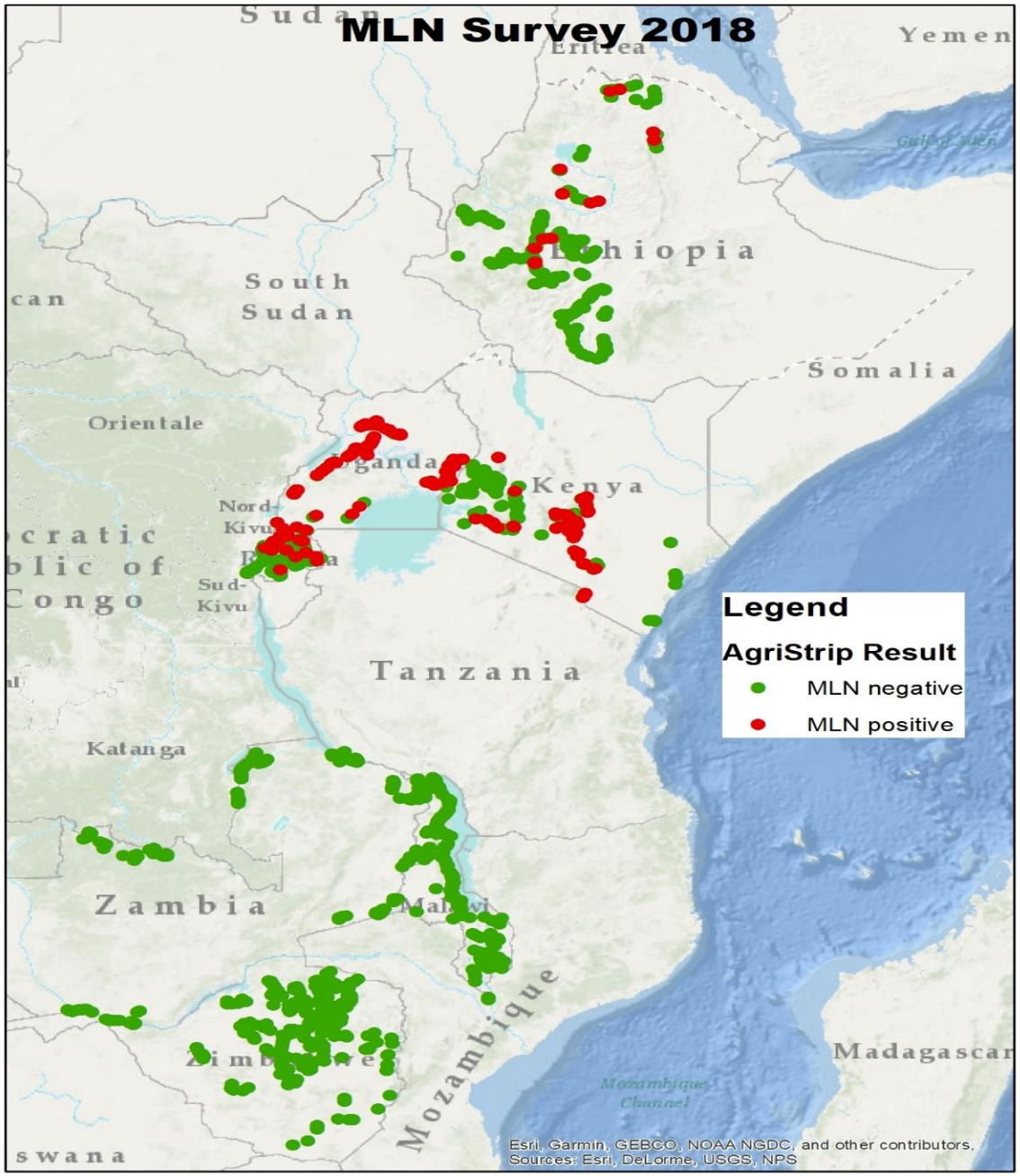
CIMMYT

MLN Surveillance Team Training –Rwanda

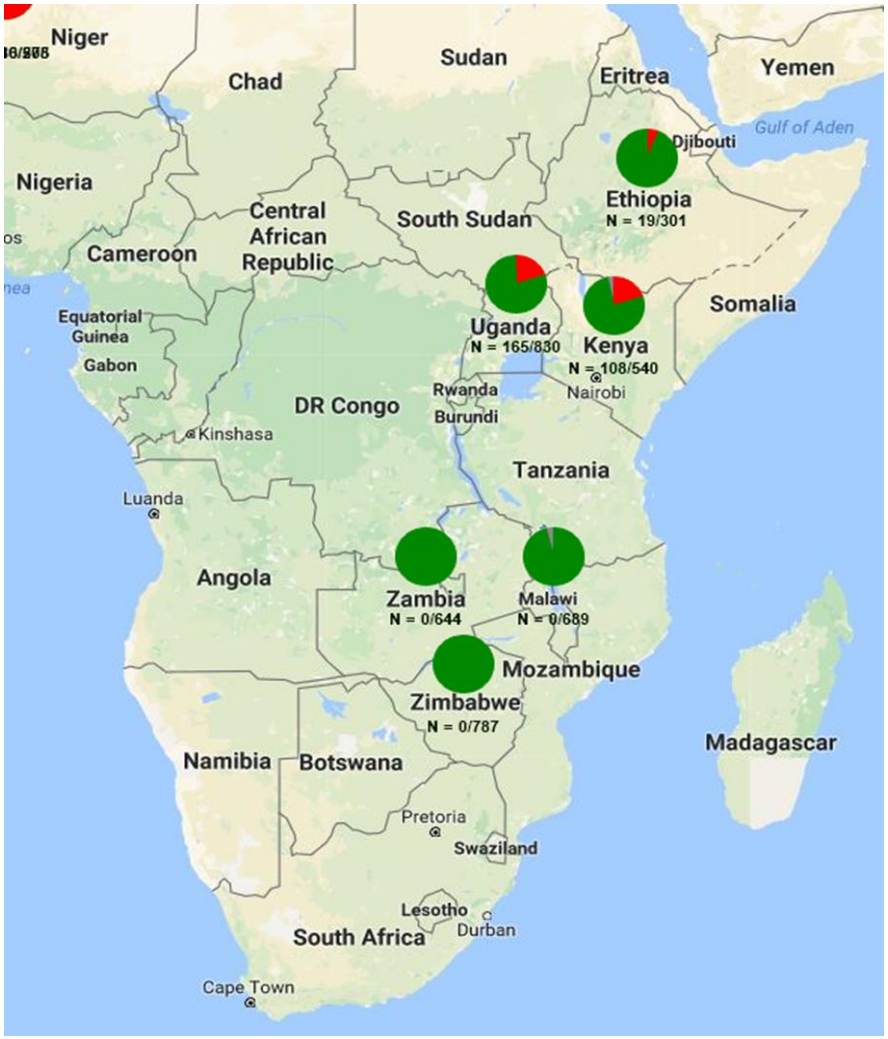
CIMMYT

Farmers and seed fields MLN Surveillance in Zimbabwe 2018

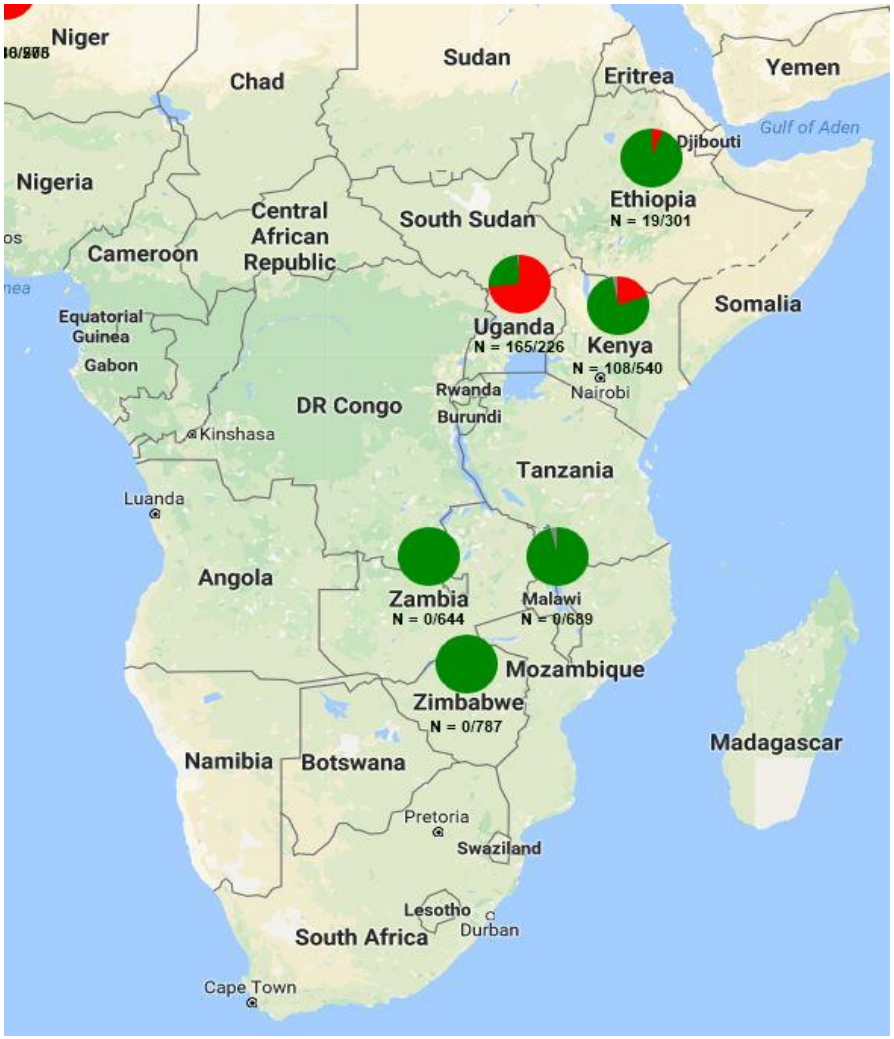
Surveyed Areas in the Region-2018



MLN Frequency Maps



2017



2018

CIMMYT

Seed analysts training sessions in CIMMYT - Harare

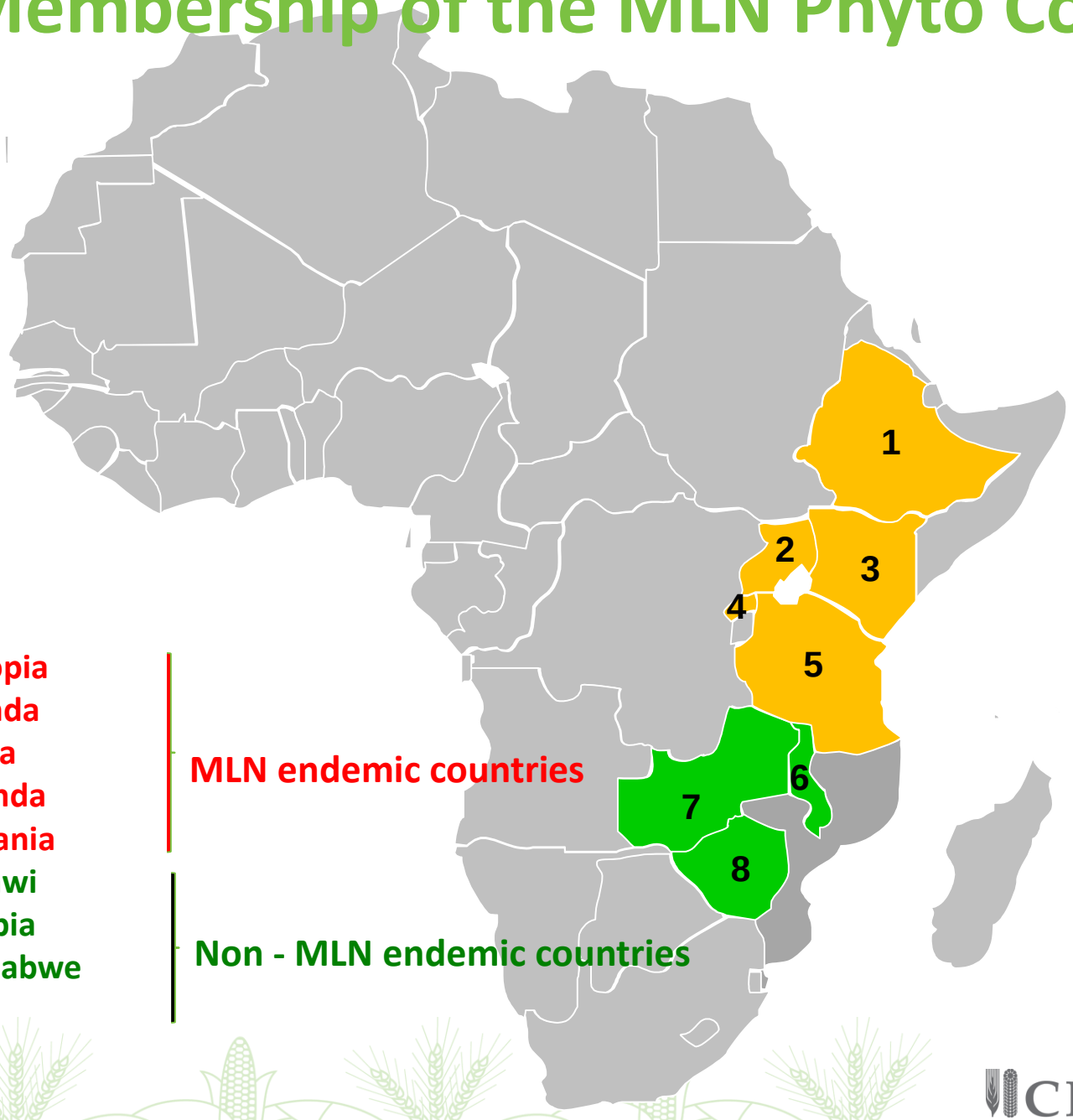
Sessions diagnostic Kits and MLN-Free Seed Production

CIMMYT

MLN Phytosanitary Community of Practice (MLN CoP)

No	Category	Institution represented	Designation
1	Phytosanitary and seed quality experts	Ministry of Agriculture	Oic of phytosanitary unit.
		NPPO	Head of NPPO
		Seed Quality Agency	Head of the Seed Quality Assurance
2	Seed industry	Regional umbrella body	MD, AFSTA
		National umbrella body	Seed Trade Association
		Major seed company	MD or Phytosanitary Officer
3	Subject matter specialists	Expert on MLN diagnostics	public/private expert on MLN diagnostics
4	CIMMYT	Management	CIMMYT-GMP Director; CRR, MLN Project Manager
		Pathology / Seed Health Unit	MLN Pathologist / Head, Seed Heath Unit
5	Donors	Observers	USAID responsible for MLN Project
6	Regional bodies	EAC / COMESA	Relevant staff

Membership of the MLN Phyto CoP



Key

1. Ethiopia
2. Uganda
3. Kenya
4. Rwanda
5. Tanzania
6. Malawi
7. Zambia
8. Zimbabwe

MLN endemic countries

Non - MLN endemic countries

CIMMYT

Integrated Approach for MLN Control

MLN: A transboundary complex disease

- Co-infection by two viruses
- Transmitted by insect vectors
- Transmitted by seed

Integrated approach

1. Seed of improved MLN tolerant hybrid from certified sources
2. Early planting to escape insect pests population build up
3. Catchment / community observe at least one month maize-free period
4. Practice crop rotation
5. If all fails, diversify to other crops

CIMMYT MR

Issues for Journalists covering MLN

- Factual coverage – No exaggeration
- Understand Research and Development
  - Principles
  - Processes
  - Durations
  - Limitations
  - Regulations

- Approaches in control methods for diseases and pests
  - Genetics – Conventional / Biotechnology
  - Pesticides
  - Cultural
  - Biological
  - Policies

Issues for Journalists covering MLN

- Avoid piling unnecessary pressures on institutions, especially governments
- Avoid hit and run
  - Remain engaged
  - Complete the story
- Opportunities for journalists
  - First-hand Knowledge
  - Adverts

Thanks!