Maize Lethal Necrosis (MLN):

Effort towards containing the spread and impact of a devastating transboundary disease in sub-Saharan Africa

Global Maize Program

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INDIAN PHYTOPATHOLOGICAL SOCIETY

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Outline:

- MLN disease
- Global Occurrence and distribution of MLN/MCMV
- Disease resistance breeding program
- Safe seed movement with effective quarantine measures
- MLN diagnosis and surveillance
- MLN pathogen-free commercial seed production and exchange
- Capacity Building to Partners on disease diagnosis and surveillance
- MLN Information Portal
- Community of practice

"Is life"

Peter and Herrera, 1994)

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Major maize diseases in Sub Saharan Africa

Turcicum Leaf Blight

Gray Leaf Spot

Fusarium Ear rot

Common Rust

Maize Lethal Necrosis

Maize streak Virus

Resistance to major diseases is important for varieties to be successful in the tropics

CGIAR

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Multi-disciplinary and multi-institutional strategy to curb the spread of MLN in sub-Saharan Africa

- Intensive germplasm screening and fast-tracked development and deployment of MLN-tolerant/resistant maize hybrids in Africa-adapted genetic backgrounds.
- Optimizing the diagnostic protocols for MLN causing viruses, especially MCMV, and capacity building of relevant public and private sector institutions on MLN diagnostics and management.
- MLN monitoring and surveillance across sub-Saharan Africa in collaboration with national plant protection organizations (NPPOs)
- Partnership with the private seed sector for production and exchange of MLN pathogen-free commercial maize seed.
- Awareness creation among relevant stakeholders about MLN management, including engagement with policy makers

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.

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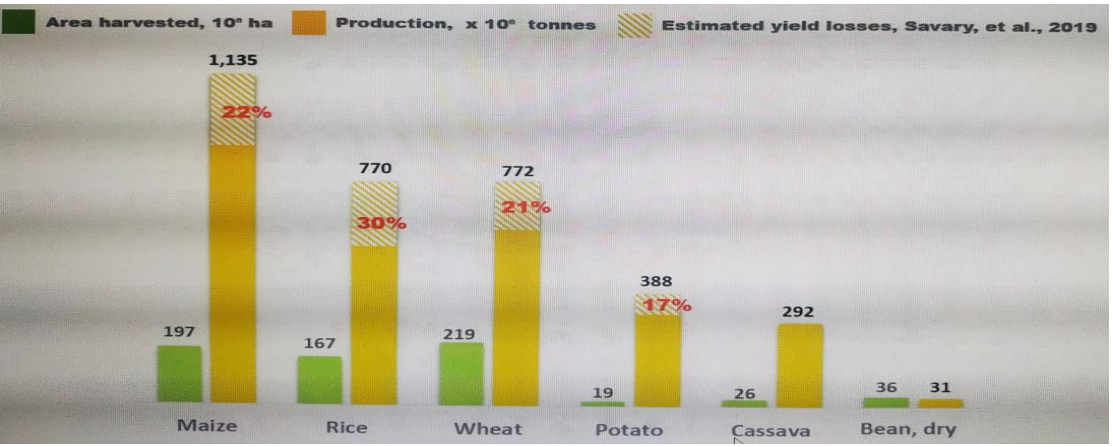
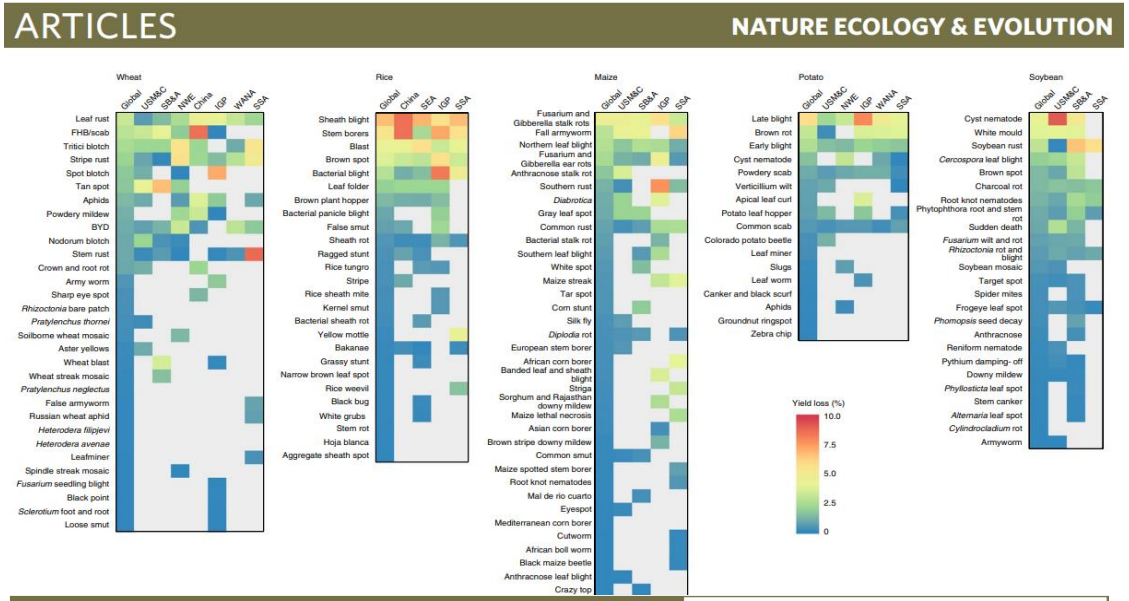
Yield losses due to plant disease, world (total) FAO, (2017)



Invasive pest and Diseases in Africa

- Insect – pests and pathogen has no geographic boundaries
- Africa has seen occurrences of several devastating pests and diseases
  - (examples: MLN (maize), Ug-99 (wheat), FAW (Maize), Fusarium wilt TR-44 (Banana)



ARTICLES
https://doi.org/10.1038/s41559-018-0793-y
nature ecology & evolution

The global burden of pathogens and pests on major food crops

Serge Savary[1], Laetitia Willocquet[1], Sarah Jane Pethybridge[2], Paul Esker[3], Neil McRoberts[4] and Andy Nelson[5*]

MLN

Wheat rust

Fall Army worm

Fusarium wilt TR-44

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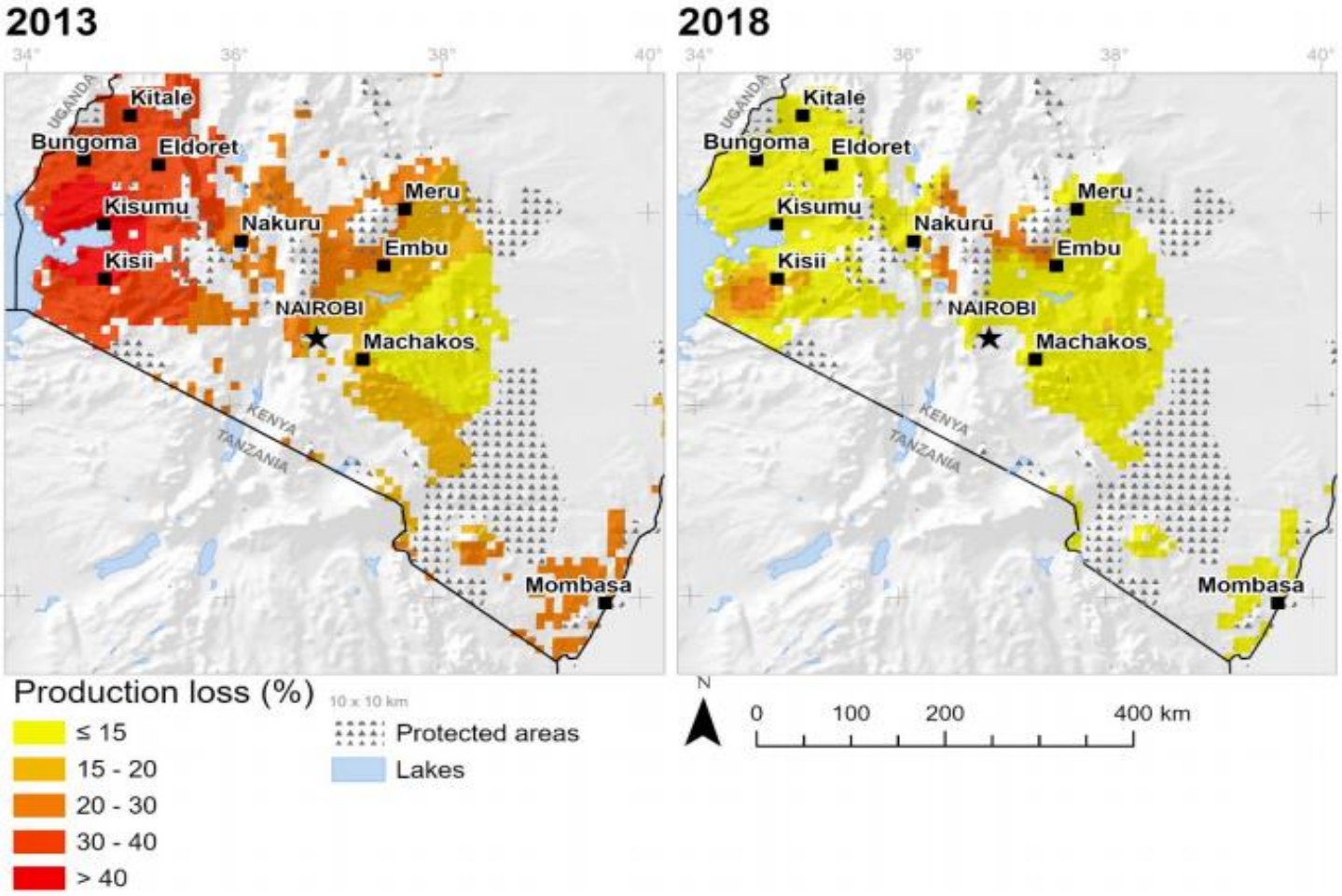
Economic Impact of MLN



In Kenya, the aggregate national loss of maize production due to MLN in 2013 was about 0.5 million tons at a value of US$ 180 million (De Groote et al., 2016).

2016: https://doi.org/10.1016/j.cropro.2015.12.003

2021: https://doi.org/10.1094/PDIS-08-20-1730-SR

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Maize Lethal Necrosis

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

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

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Disease Symptoms

- Chlorotic specs, streaks mosaic, mottling, Necrosis
- Dying leaves, leading to premature plant death
- Failure to tassel and sterility in male plants
- Malformed or no ears
- Rotting cob

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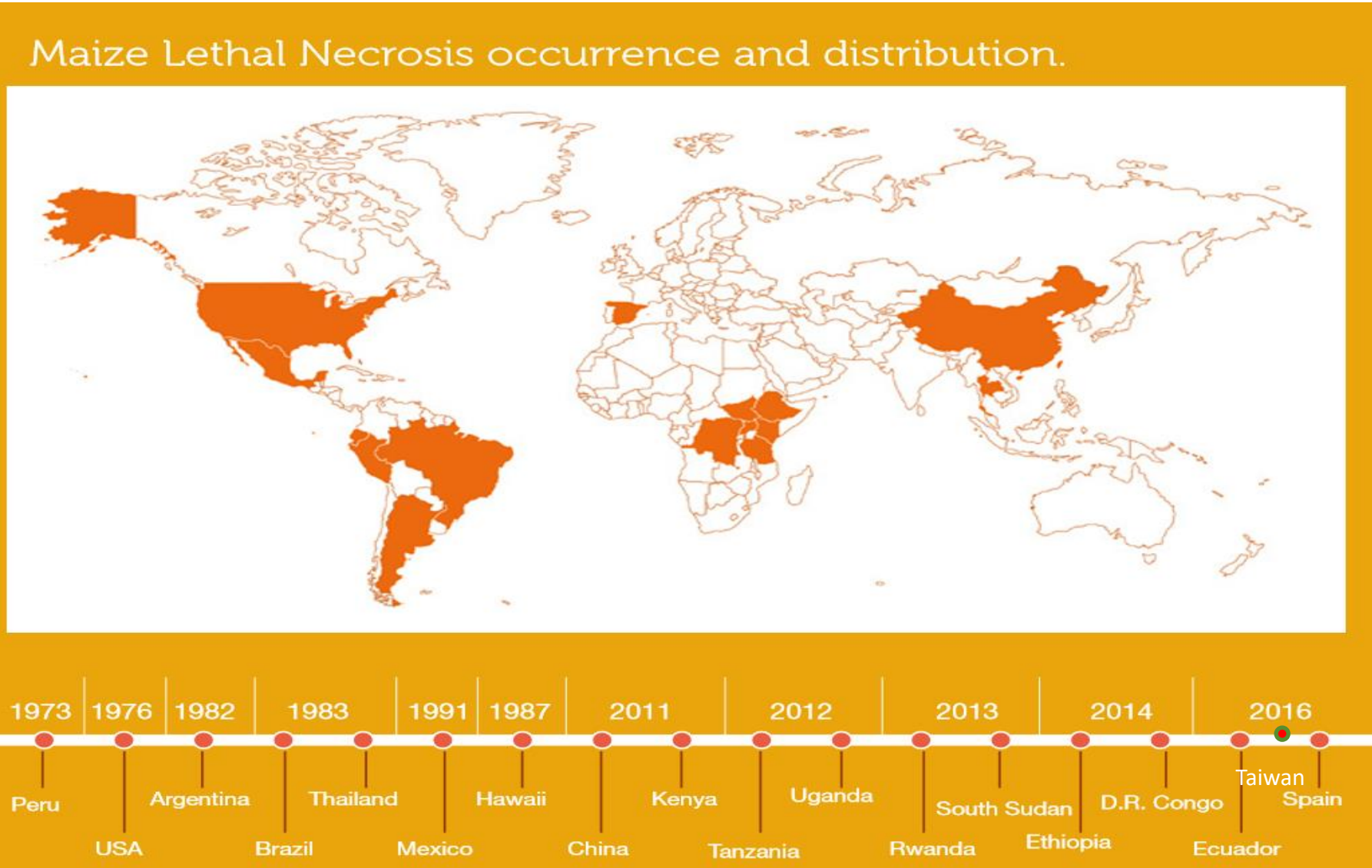
Global Occurrence and distribution of MLN/MCMV



Why is the MLN devastating in EA?

- MCMV is **new** to the region
- Potentially new strains of SCMV/MDMV
- **Conducive environment** – continuous maize cropping in certain areas leading to continuous build-up of virus inoculum
- **Seed contamination by** MLN-causing viruses, especially MCMV, besides local spread through insect vectors
- Widespread cultivation of **susceptible germplasm** that has never been screened for MCMV
- **A very large proportion of commercial maize varieties in eastern Africa as well as other regions in sub-Saharan Africa are highly vulnerable to MLN.**

Highlights

- Maize lethal necrosis (MLN) emerged as a serious threat to maize production and livelihoods of smallholders in eastern Africa since 2011.

- An intensive multi-disciplinary and multi-institutional strategy is being implemented to curb the spread of MLN in sub-Saharan Africa, and mitigate the impact of the disease.

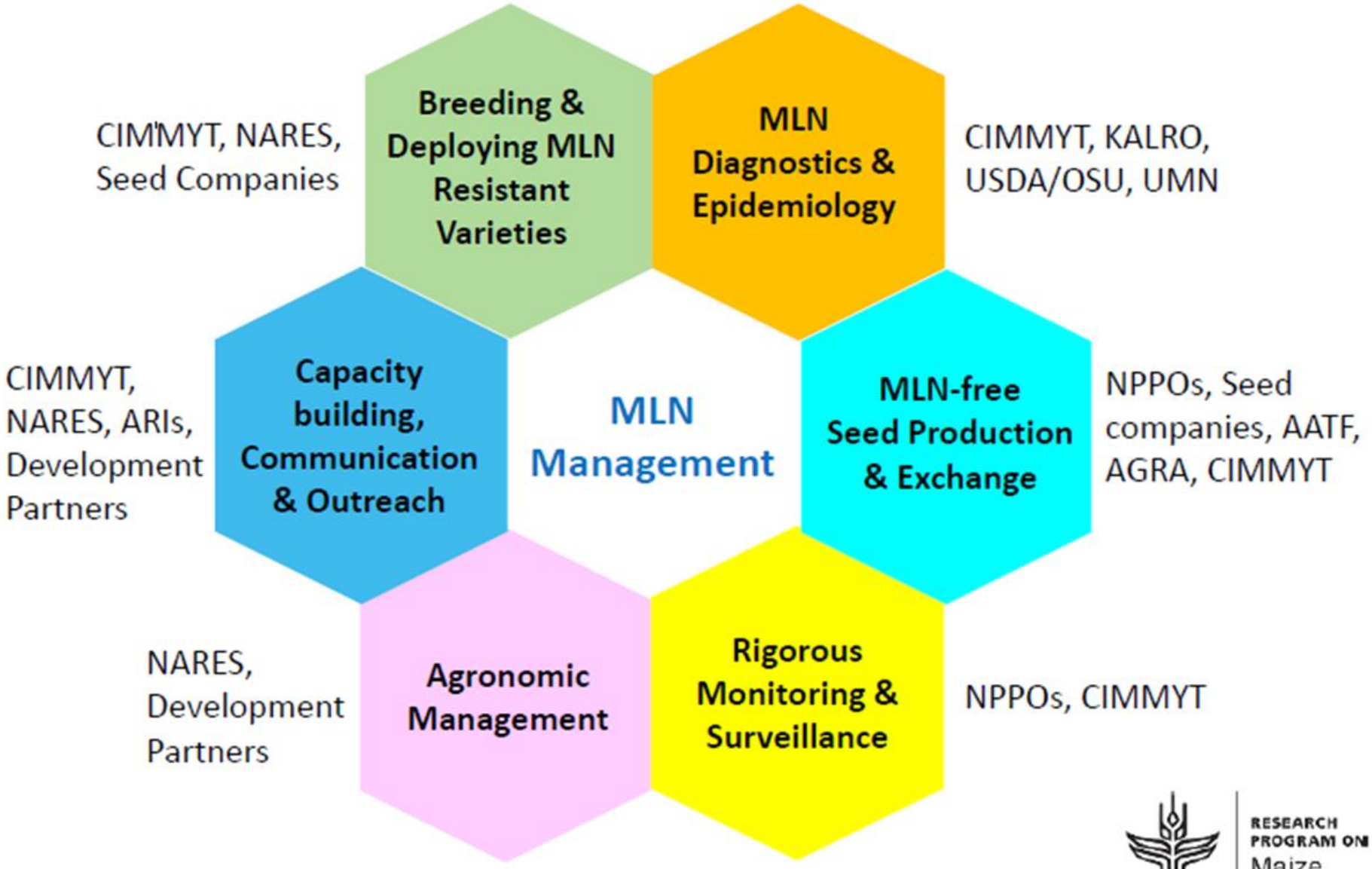
- Intensive germplasm screening led to identification of MLN-resistant sources, and fast-tracked development and commercial release of 19 MLN-tolerant/resistant hybrids in eastern Africa.

- Marker-assisted breeding led to successful conversion of 52 elite but MLN-susceptible inbred lines into MLN-resistant versions.

- MLN/MCMV diagnostic protocols have been optimized, and personnel from relevant public and private sector institutions trained on MLN diagnostics, monitoring and surveillance.

Tackling a Complex Challenge

Success through Integration of Various Components



CGIAR RESEARCH PROGRAM ON Maize

Developing and deploying MLN resistant hybrids

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MLN Phenotyping Service [2014-till date]

Year	CIMMYT		NARS		Private Seed companies		Total	
	Entries	Rows	Entries	Rows	Entries	Rows	Entries	Rows
2014	25715	52854	5133	10627	10421	17102	41,269	80,583
2015	7022	10284	3372	5077	3263	4038	13,657	19,399
2016	23789	33537	10913	12791	10217	12739	44,919	59,067
2017	16174	24066	4580	5867	4162	6878	24,916	36,811
2018	29816	31954	8548	8165	8332	8735	46,696	48,854
2019	21563	35891	1047	2094	3169	5774	25,779	43,759
2020	4123	9680	939	3604	2397	6316	7,459	19,600
2021	5841	13718	2125	4250	2661	3973	10,627	21,941
Total	**134,043**	**211,984**	**36,657**	**52,475**	**44,622**	**65,555**	**215,322**	**330,014**

- **MLN – PSMS (Phenotyping management service system)** is in place for smooth operation, which is well appreciated by partners and EiB.
- **215,322 germplasm entries (>330,014 rows)** screened against MLN & MCMV under artificial inoculation at the Naivasha facility since 2014. **Heritability : 0.85 to 0.99 [CIMMYT : 65%; NARES : 15%; SME's : 20%]**
- Impact : so far, **19 MLN resistant / tolerant hybrids released** in eastern Africa.
- From less than 5 inbred lines with tolerance/resistance to MLN in 2013, today we have **more than 50 elite and diverse CIMMYT lines with MLN resistance**

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MLN Screening Facility at KALRO-Naivasha, Kenya

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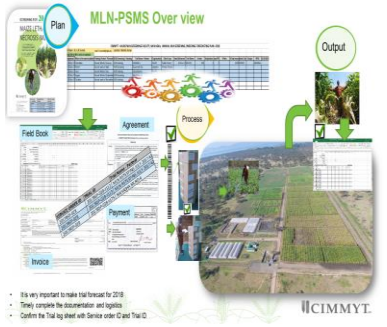
MLN Phenotyping facility – Center of Excellence

Inoculation Protocol

Facilities

Process



Phytosanitation

MLN Screening protocol, calendar and Capacity - Naivasha

Cycle	capacity	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1st	12000	P	P	I	E	E							
2nd	25000				P	P	I	E	E				
3rd	12000							P	P	I	E	E	
4th	25000	E								P	P	I	E
5th	12000	I	E	E								P	P

Planting	**P**
Inoculation	I
Evaluation	E

Disease Rating Scale (1-9)

Score	Description
1 =	Completely clean plants with no visible MLN disease symptoms
2 =	Fine or no chlorotic specks, but no loss of plant vigor
3 =	Mild chlorotic streaks on emerging leaves
4 =	Moderate chlorotic streaks on emerging leaves
5 =	Chlorotic streaks and mottling throughout the plant
6 =	Intense chlorotic mottling throughout the plant, with necrosis of leaf margins
7 =	Severe chlorotic mottling, mosaic, and leaf necrosis all through the plant
8 =	Severe chlorotic mottling, leaf necrosis, dead heart and premature death of plants.
9 =	Complete plant necrosis, and dead plants

You can also see: mln.cimmyt.org

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Lines

Hybrids

Responses of the Inbred Lines: the “Good” and the “Bad”

CML442

CML443

CML448

CML395

CML444

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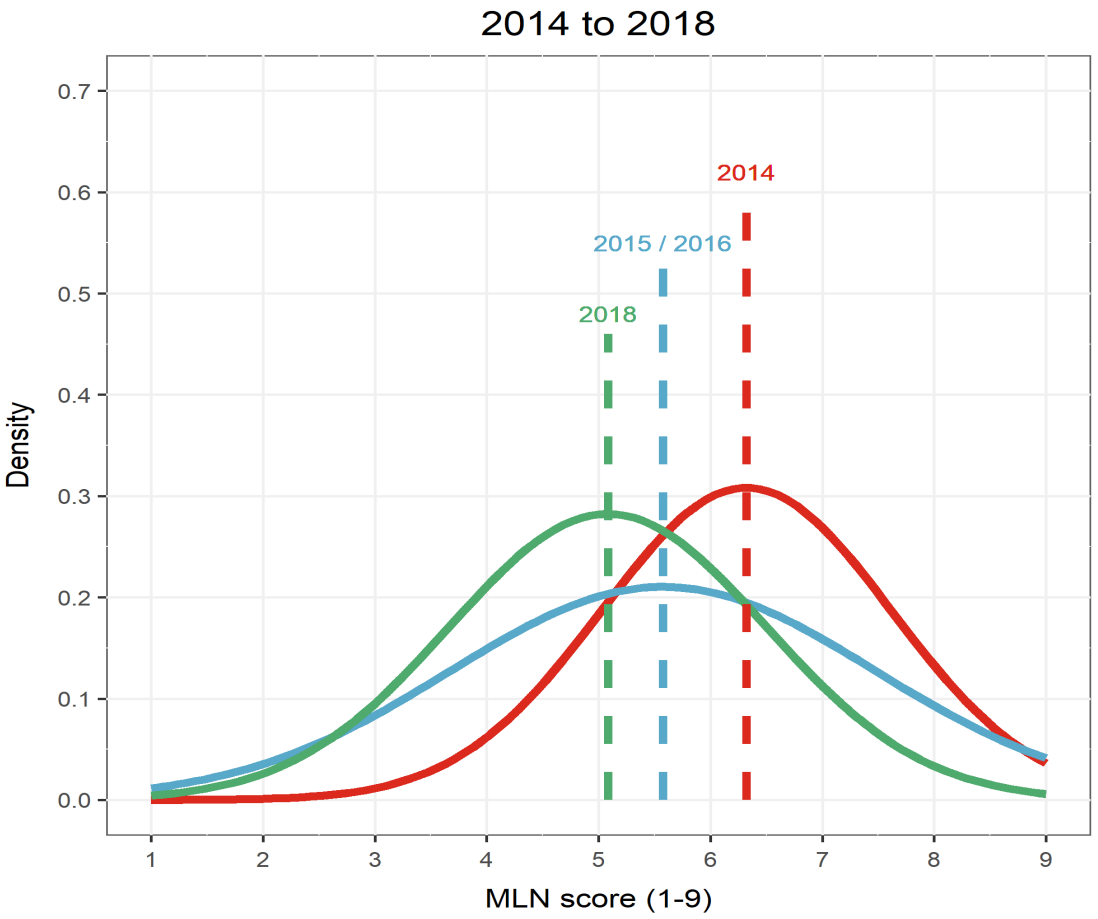
Breeding progress from 2014-2018

Year	# lines evaluated
2014	**2876**
2016	**1522**
2018	**909**
Total	**5307**



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Demonstration plots of tolerant hybrids and susceptible check under natural MLN infestation in Tanzania and Artificial inoculation in Kenya

Natural Hot Spot – Site Babati, Tanzania

•Artificial Inoculated – Site Naivasha, Kenya

Performance of MLN tolerant hybrids under natural MLN

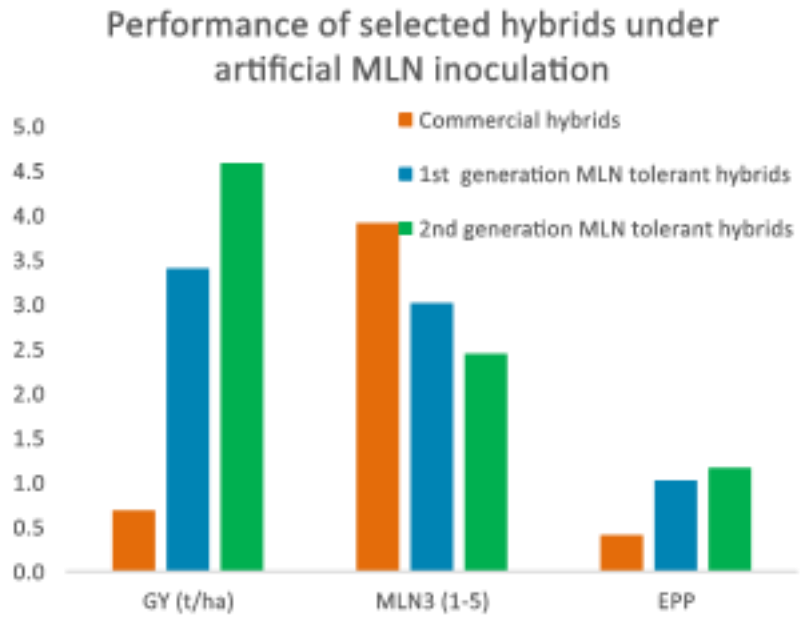
Babati (Tanzanian)

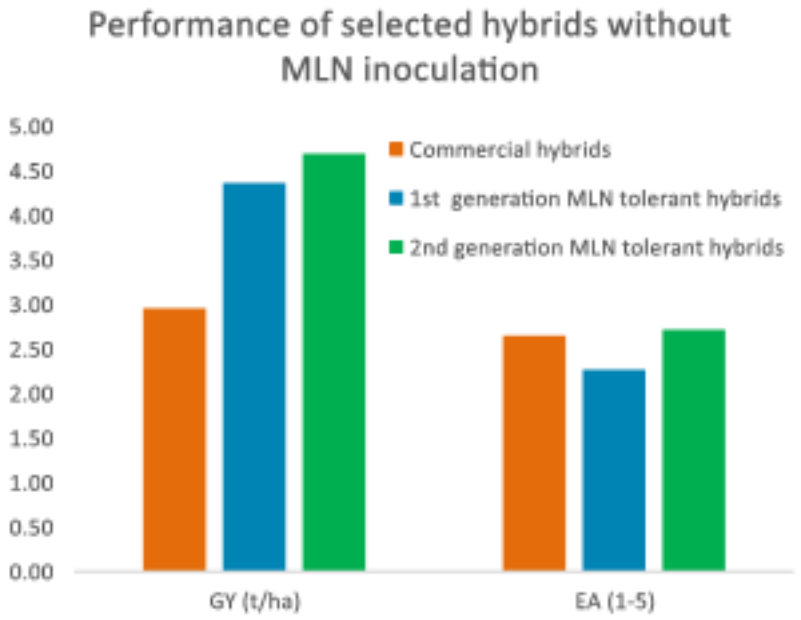
•Wondogent (Ethiopia)

Yield at Babati (Tanzanian)

Kiboko (Kenya)-Optimum

Results of Yield loss study due to MLN





	GY (t/ha)	EPP	MLN3(1-5)
Heritability	0.8	0.5	0.93
n Replicates	3.0	3.0	3.00
n Locations	2.0	2.0	2.00

	GY (t/ha)	EA (1-5)
Heritability	0.69	0.59
n Replicates	3	3

	Yield (t/ha)without MLN	Yield (t/ha) under MLN	Yield loss duet to MLN (%)
Commercial hybrids	3.0	0.7	77.7
1st generation MLN tolerant hybrids	4.4	3.4	22.9
2nd generation MLN tolerant hybrids	4.7	4.6	3.1

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MLN tolerant / resistant Hybrids released in Eastern Africa

S.No.	CIMMYT-derived MLN-tolerant Hybrid	Year of Release	Country	Status
1	H12ML	2013	Kenya	Certified seed to be produced and commercialized by KSC in 2017
2	H13ML	2014	Kenya	Being commercialized by KSC.
3	Meru HB607	2014	Tanzania	Certified seed expected to be produced by Meru Agro in 2017
4	Bazooka UH5354	2014	Uganda	Being commercialized by NASECO
5	WE5135	2016	Kenya	Recommended for release through KALRO
6	WE5140	2016	Kenya	Recommended for release through KALRO
7	WE6109	2016	Kenya	Recommended for release through KALRO
8	WE6110	2016	Kenya	Recommended for release through KALRO
9	KATEH16-01	2017	Kenya	Recommended for release through KALRO
10	KATEH16-02	2017	Kenya	Recommended for release through KALRO
11	KATEH16-03	2017	Kenya	Recommended for release through KALRO
12	WE7117	2018	Kenya	Recommended for release through KALRO
13	WE7119	2018	Kenya	Recommended for release through KALRO
14	WE7118	2018	Kenya	Recommended for release through KALRO
15	CKMLN150074	2019	Kenya	Recommended for release through Seed Co. Ltd
16	WE5135	2019	Tanzania	Recommended for release through COSTEC
17	WE7118	2019	Tanzania	Recommended for release through COSTEC
18	WE5141	2019	Tanzania	Recommended for release through COSTEC
19	WE7133	2019	Tanzania	Recommended for release through COSTEC

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Release of MLN-tolerant/Resistant Hybrids

19 CIMMYT-derived, MLN-tolerant/resistant hybrids released so far in Eastern Africa

Comparison of MLN-tolerant/resistant hybrids versus MLN-susceptible commercial checks

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H6506, an MLN-tolerant and DT Maize Hybrid (CIMMYT-licensed to KSC) to replace H516 in Kenya

500 acres certified seed production (500 tons) by Kenya Seed Co. in 2019

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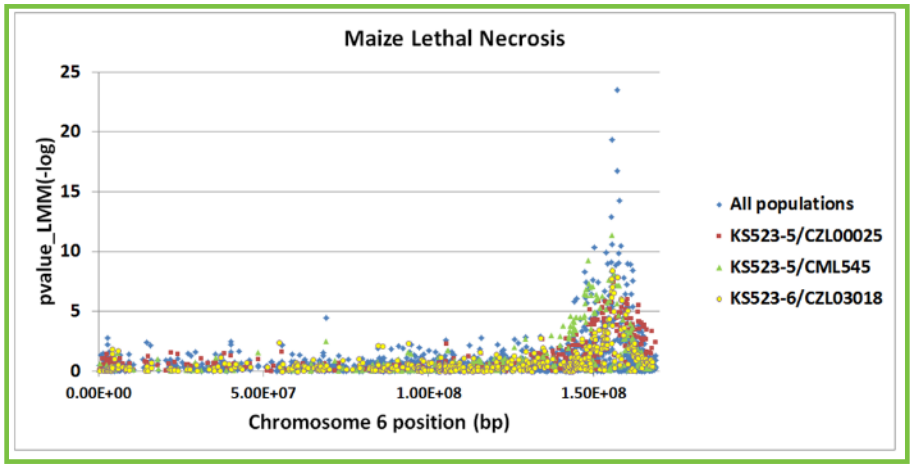
Molecular breeding for developing MLN – resistant germplasm

qMLN_06.157



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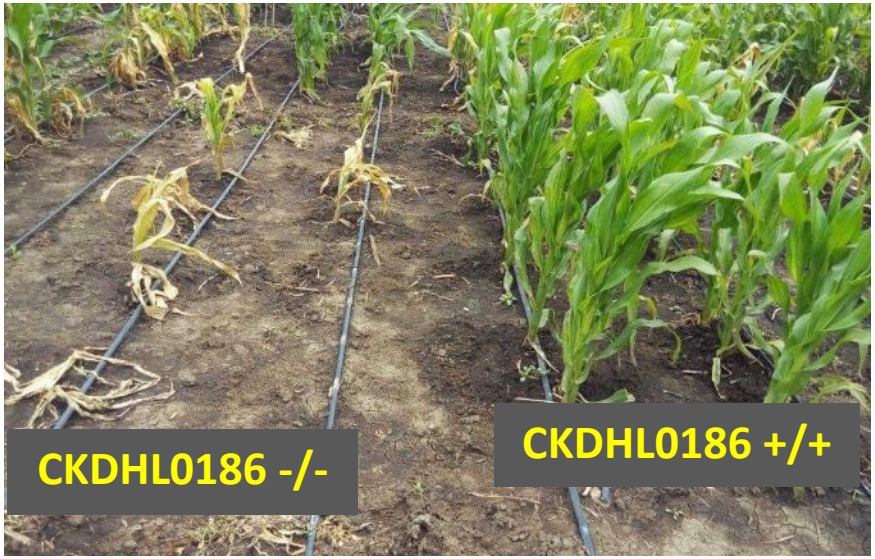
Introgressing MLN Resistance through Molecular Breeding



Fast-tracked conversion of **52** elite DT but MLN susceptible CIMMYT lines into MLN-resistant versions

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Safe Germplasm exchange and distribution

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

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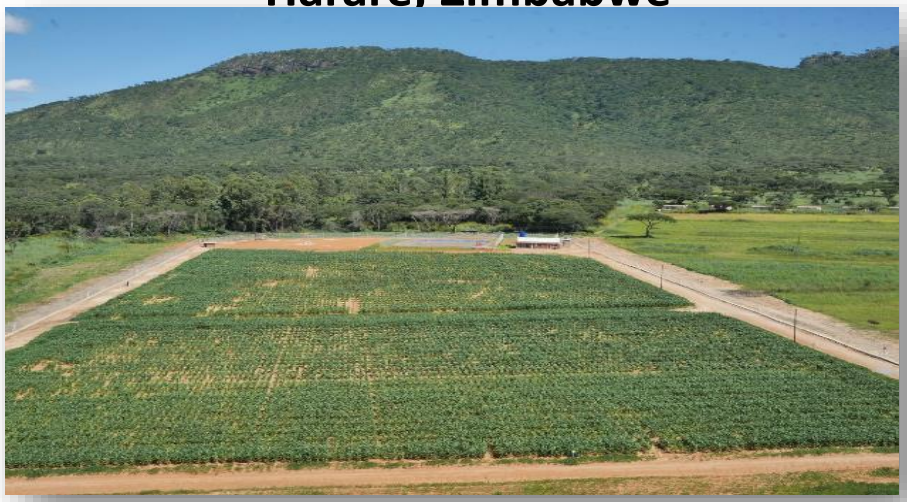
MLN Quarantine and Screening facilities in SSA

MLN Quarantine facility

Harare, Zimbabwe



- Surveillance and diagnosis for MLN
- Seed production, selfing and Crossing.
- Destroy the maize crop in the farm and 50 KM vicinity, if found MCMV positive.
- Distribute Maize germplasm, after confirming negative to MCMV

•MLN Screening and Quarantine facility

•Naivasha, Kenya

- Germplasm Screening for MLN, MCMV & SCMV
- No seed production, selfing and Crossing.
- No return of seeds after screening, only provide the data.

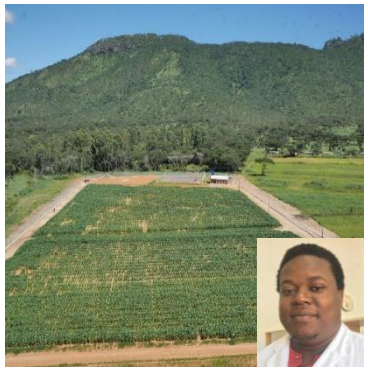
Safe seed movement with effective quarantine measures

Field scouting CIMMYT & KEPHIS at Kiboko

Seed samples test – CIMMYT lab, Nairobi

Kenya Plant Health Inspectorate Service

Seed test in KEPHIS

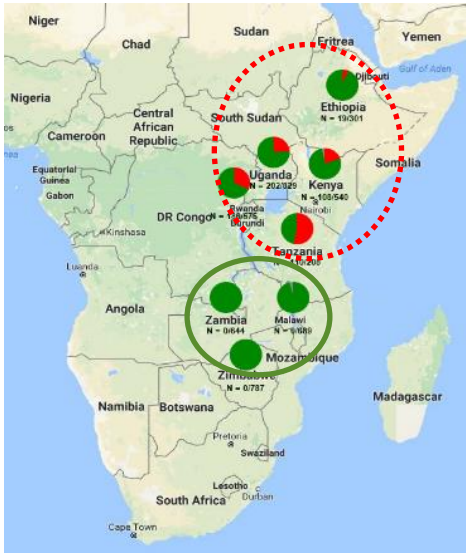


Seed test in CIMMYT quarantine site and Harare lab

Progress made in Kenya

Progress made in Zimbawe

Year	Field inspection	Seed testing	Samples tested for causing MLN tested	Lines planted and released from facility	Incidence of MLN in pre-released seed
2017	750	1335	Established Quarantine facility in Mazowe, Harare, 2016		
2018	854	1444			
2019	503	3451	>35000	>6800	0
2020	649	2345			
2021	450	1991			



Current MLN Status As on Nov, 2021

>10,000 composite seed samples were tested and sent the seeds to Harare, endemic countries, no single samples found positive so far after the seeds received since 2016.

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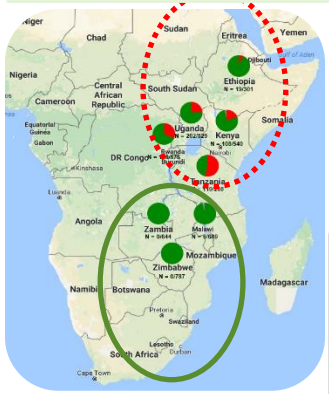
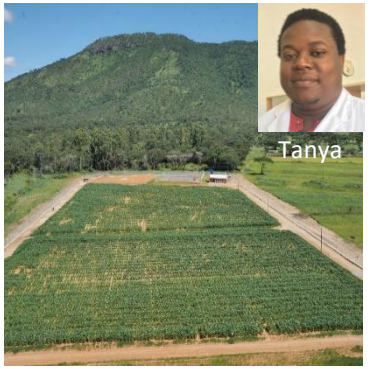
Safe seed movement with effective quarantine measures

Current MLN Status
As on Dec 2018



Kenya Plant Health Inspectorate Service



Kiboko, Kenya

Scouting

- Scout for MLN suspect samples
- Diagnosis
- Destroy plants with MLN +ve
- Arrange seed for

SHL-Nairobi

Diagnosis

- Seed Diagnosis
- Destroy +ve sample
- Comply check list
- Arrange –ve sample to KEPHIS

KEPHIS, Kenya

Certification

- Field inspection
- Seed Diagnosis
- Destroy +ve sample
- Arrange Phyto certificate

-Harare, Zimbabwe

Surveillance

- Seed Diagnosis
- Grow out in quarantine facility
- Scouting
- Diagnosis
- Destroy maize crop if any suspect or positive

Progress made in Kenya

Progress made in Zimbawe

Year	Field inspection	Seed testing	Seed Shipment entries from Kenya lots	Samples tested for causing	Lines planted and released from	Incidence of MLN in pre-
2016	854	906	3249	Established Quarantine facility in Mazoe, Harare, 2016		
2017	503	1481	1338	>35000	>6800	0
2018	649	995	8415			
2019	503	3451	12000			
2020	649	2345	11450			

Understanding and preventing seed transmission of MLN in Africa

- BMGF-supported Project, initiated in June 2016; will be completed by May 2020.
- CIMMYT, KALRO, USDA/Ohio State University, Univ. of Minnesota, and IITA

Key Questions:

1. What factors contribute to seed contamination of MCMV?
2. Where is MCMV localized most in the seed?
3. Is there an influence of genetic background and developmental stage of infection on MCMV seed transmission?
4. How long can MCMV persist in the soil?

MLN Diagnostics and Management Project

Project Objectives

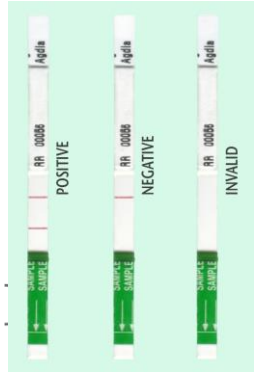
a) Prevent the spread of MLN, especially Maize Chlorotic Mottle Virus (MCMV), from the MLN-endemic countries in eastern Africa to non-endemic countries in sub-Saharan Africa;

b) 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

c) To establish and operate 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.

MLN farmers' fields Surveillance

Using ODK and Immunostrip

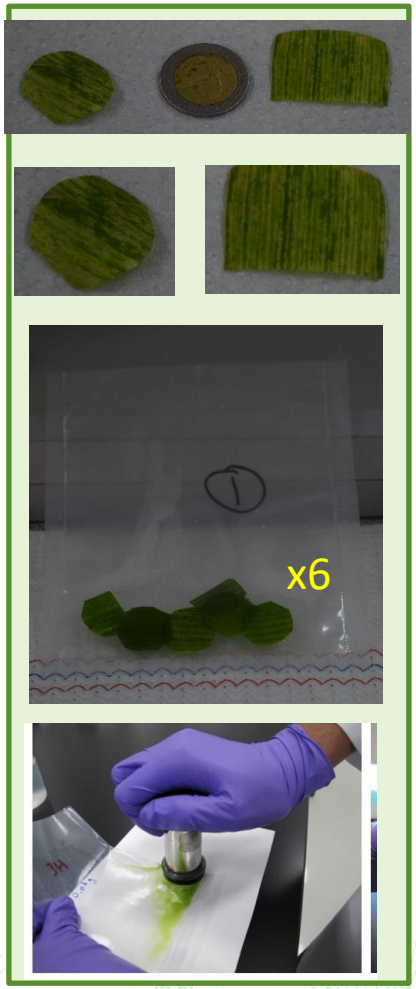


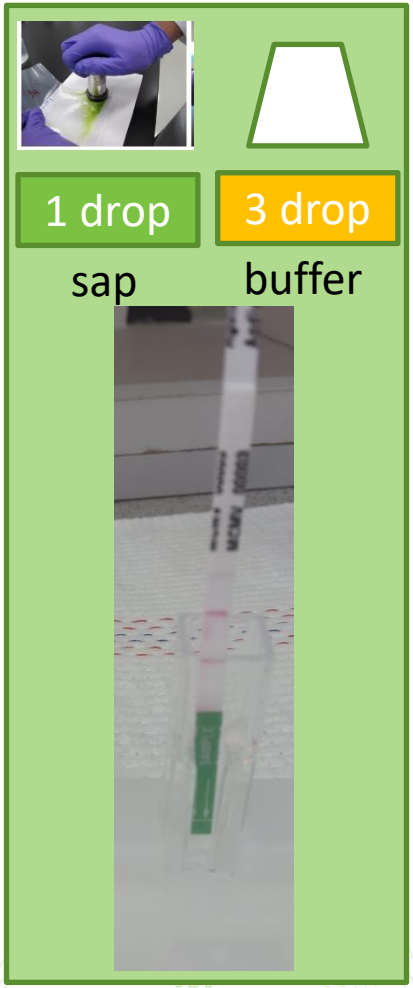
Sample collection

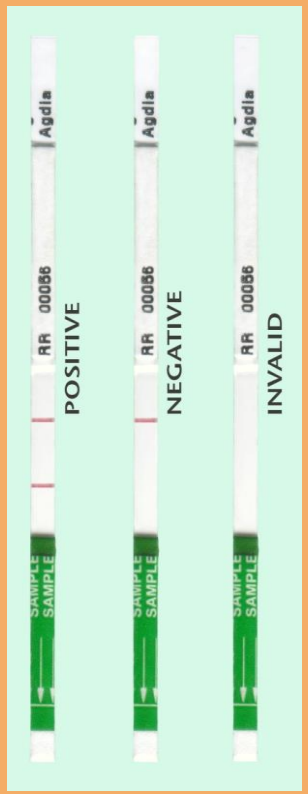
Sample Preparation

Immunostrp test

Documentation







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15 min

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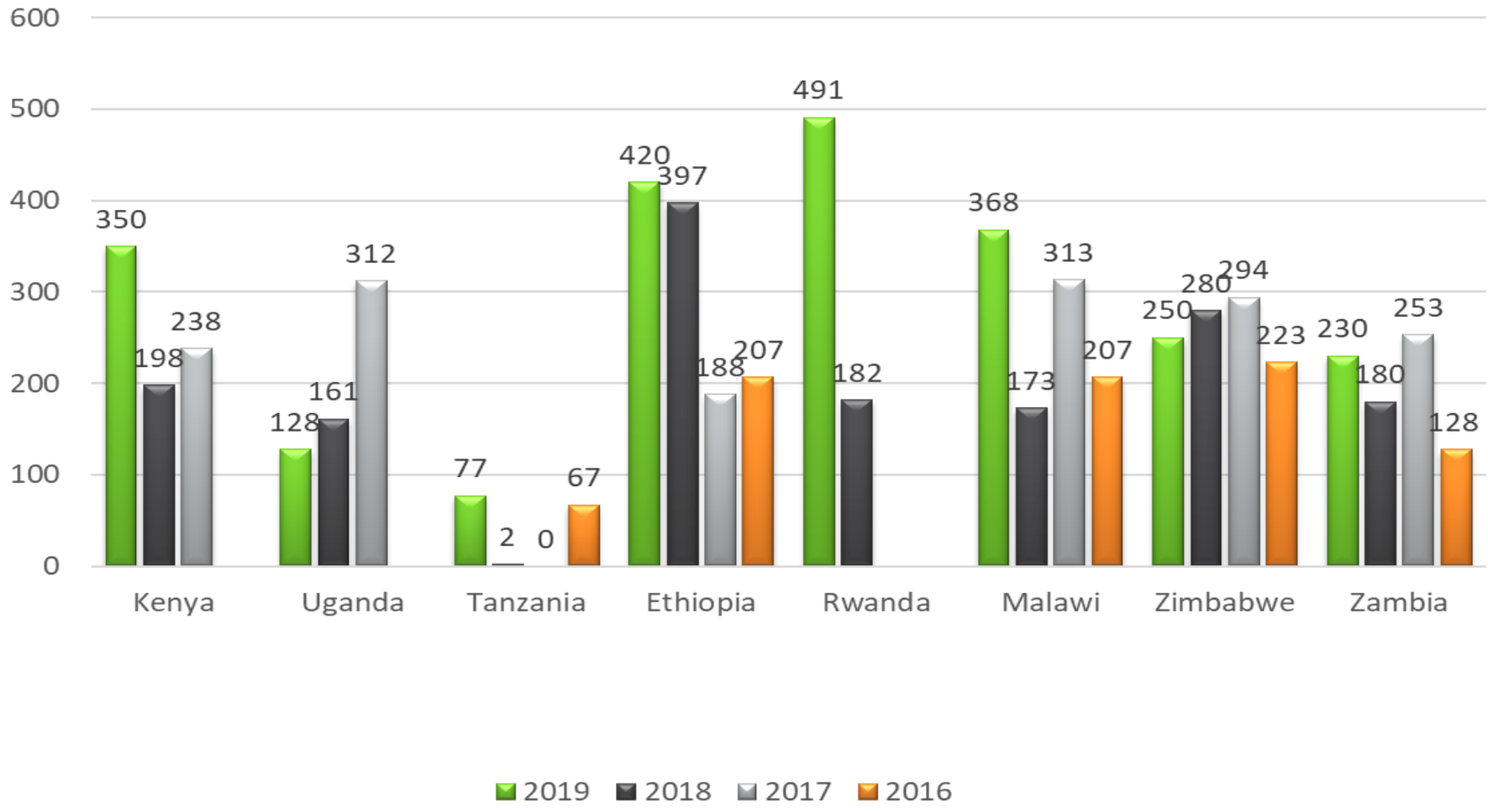
MLN Surveillance points 2016 - 2019



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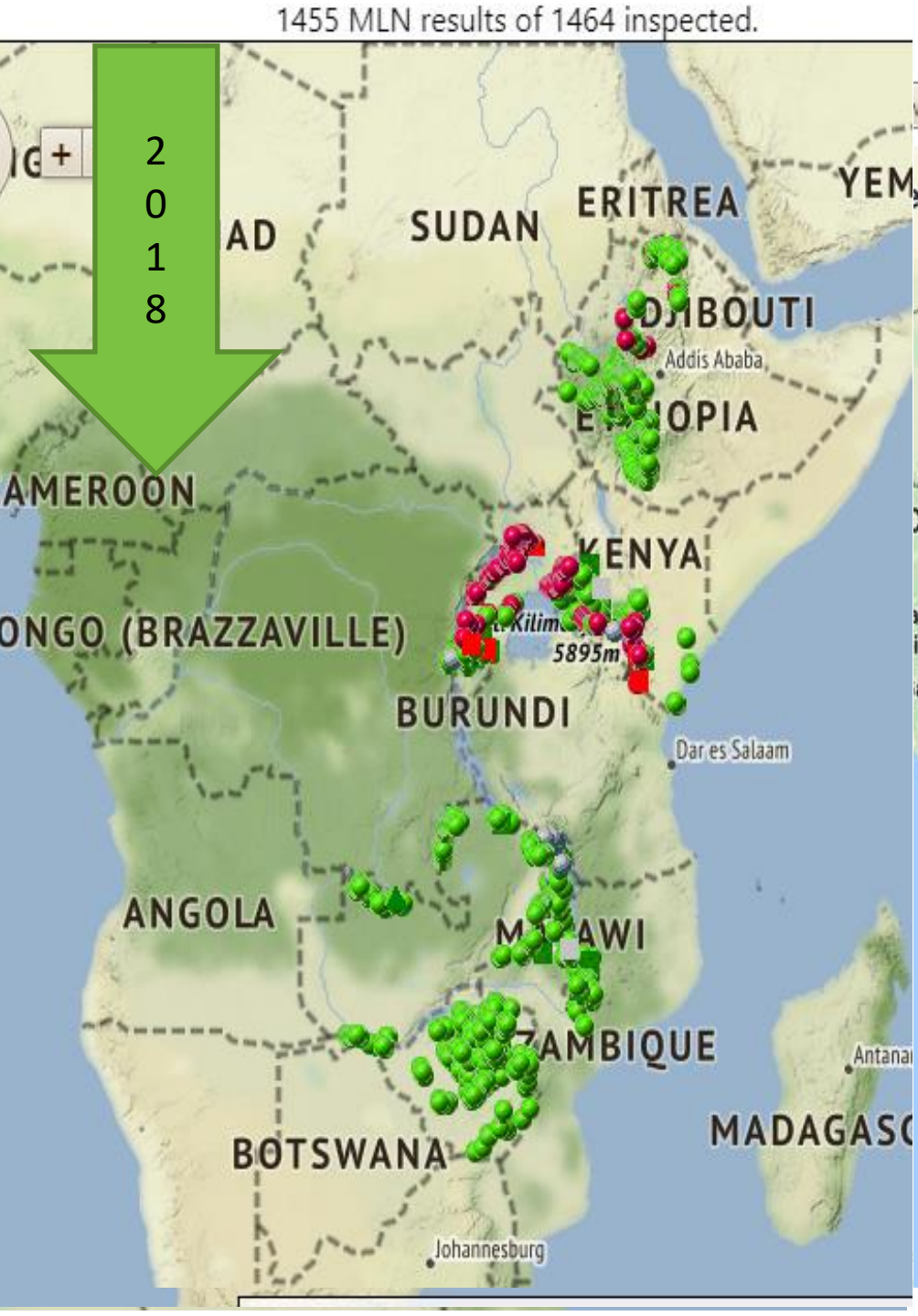
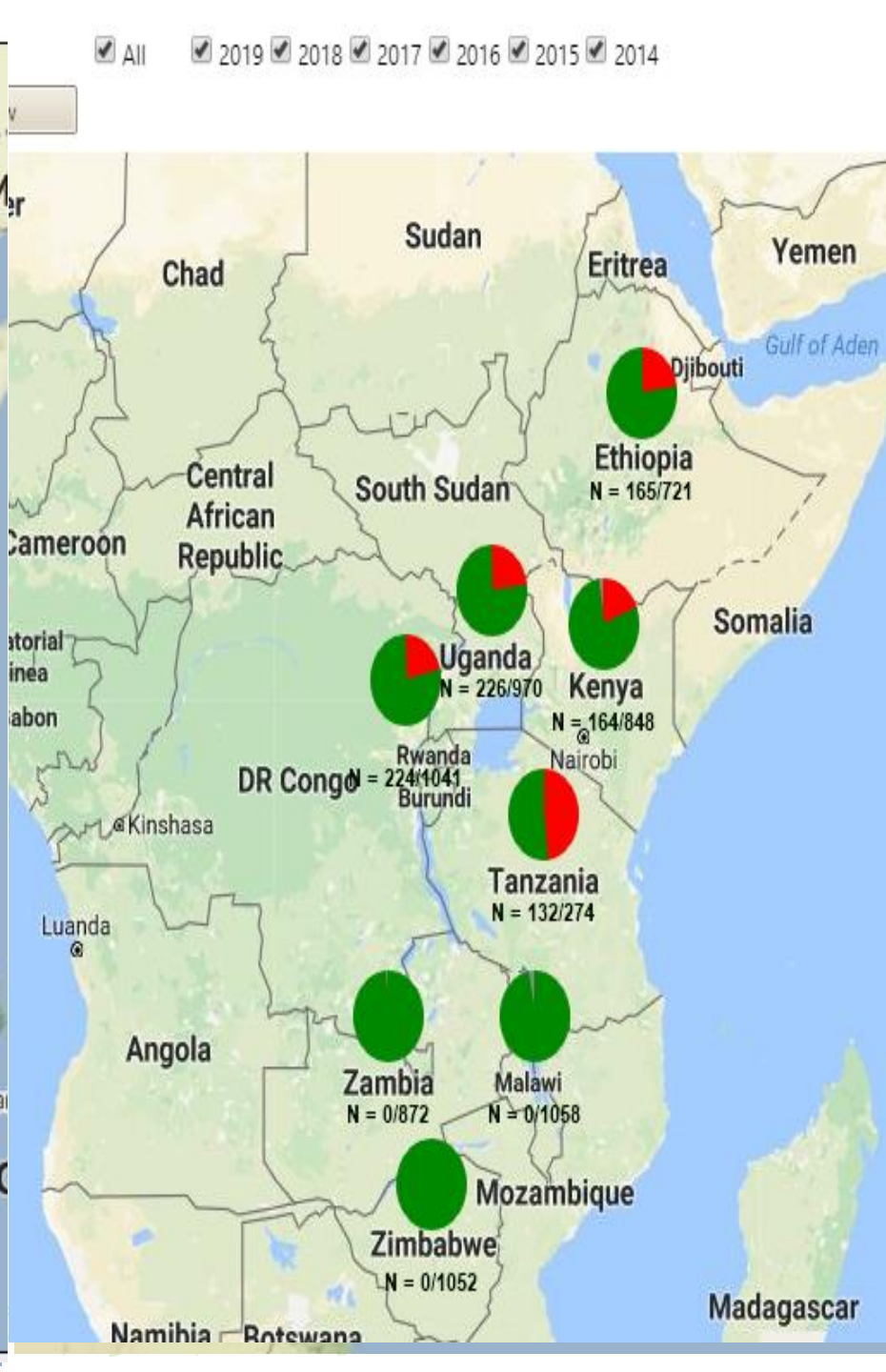
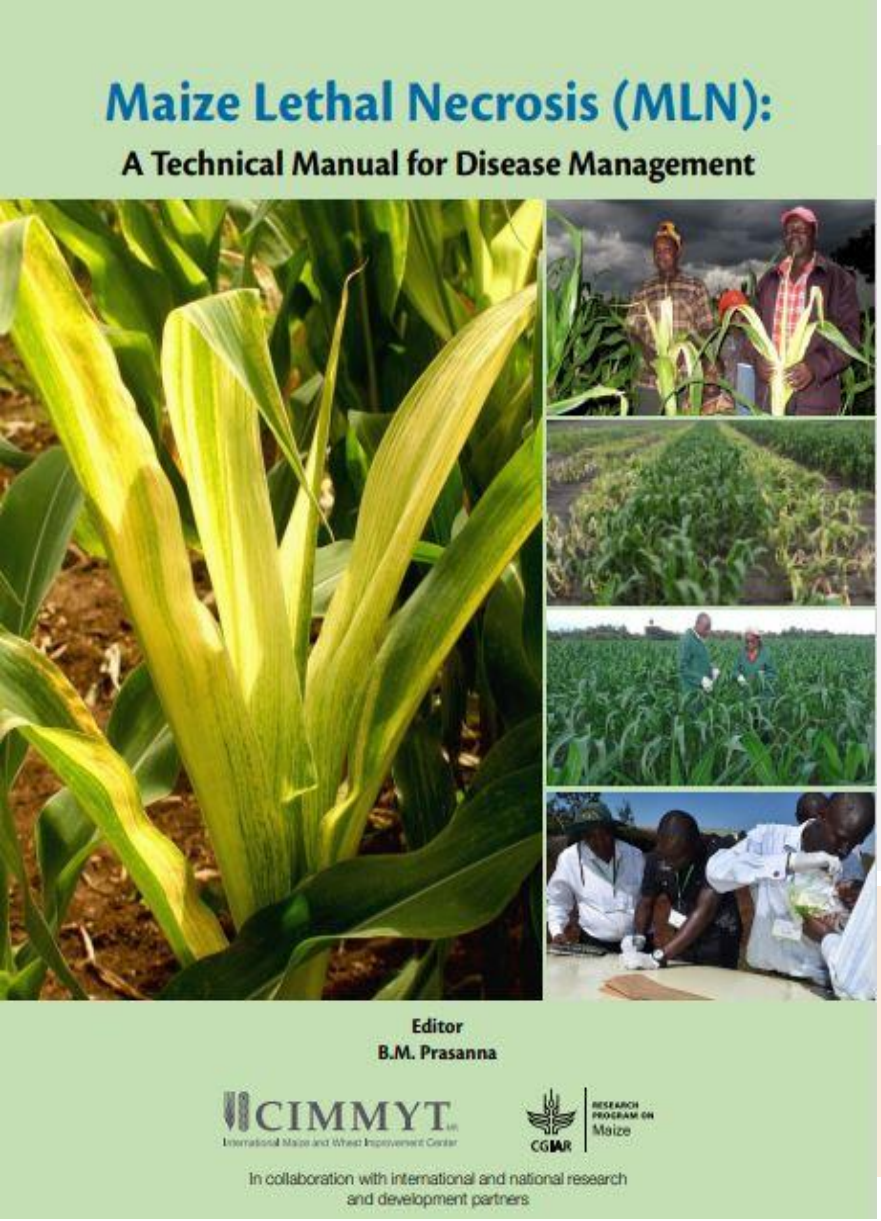

1455 MLN results of 1464 inspected.
2018
SUDAN
ERITREA
DJIBOUTI
Addis Ababa
KENYA
5895m
BURUNDI
Dar es Salaam
ANGOLA
BOTSWANA
Johannesburg


All
2019
2018
2017
2016
2015
2014
Sudan
Chad
Eritrea
Yemen
Gulf of Aden
Djibouti
Ethiopia
N = 165/721
Central African Republic
South Sudan
Cameroon
Somalia
Uganda
N = 226/970
Kenya
N = 164/848
Nairobi
Rwanda
N = 224/1041
Burundi
DR Congo
Kinshasa
Tanzania
N = 132/274
Luanda
Angola
Zambia
N = 0/872
Malawi
N = 0/1058
Mozambique
Zimbabwe
N = 0/1052
Madagascar
Namibia
Botswana



- The manual is organized in 10 chapters, as below:

- **Chapter 1:** Maize Lethal Necrosis (MLN) in Africa: Incidence, Impact, Rapid Response, and Management
- **Chapter 2:** MLN-causing Viruses in Africa, and their Symptoms
- **Chapter 3:** Modes of Transmission of MLN-causing Viruses
- **Chapter 4:** Maize Germplasm Phenotyping for MLN, MCMV and SCMV under Artificial Inoculation at the MLN Screening Facility, Naivasha, Kenya
- **Chapter 5:** MLN Surveillance, Leaf and Seed Sampling Protocols
- **Chapter 6:** MCMV, SCMV, and MLN Diagnostic Protocols
- **Chapter 7:** Managing MLN Quarantine Facilities: Phytosanitary Guidelines
- **Chapter 8:** MLN Pathogen-free Commercial Seed Production: Standard Operating Procedures
- **Chapter 9:** MLN Early Warning and Emergency Preparedness Plans
- **Chapter 10:** MLN Management: Conclusions and Future Perspective

This publication on Maize Lethal Necrosis (MLN): A Technical Manual for Disease Management is intended as a comprehensive guide on best practices and protocols for sustainable management of the MLN disease in countries where the disease is already prevalent as well as for technically supporting “high-risk” countries globally for proactive implementation of practices that can possibly prevent the incursion and spread of the disease

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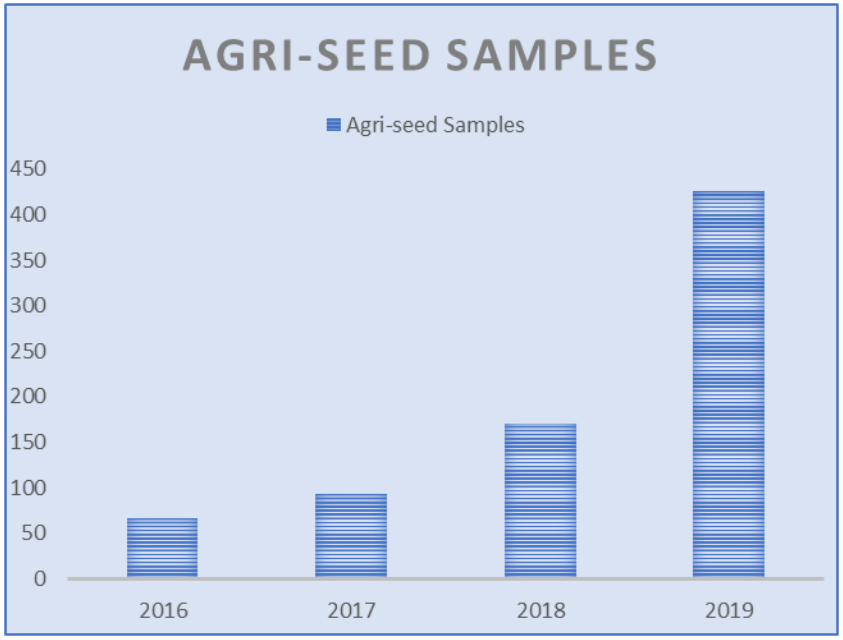
Agri -seed dealers' surveillance 2019

2016 - 2019

Country	No. of maize Agri-seed dealers	No. seed samples tested	
		+ve	-ve
RWANDA	0	N/A	N/A
MALAWI	0	0	144
ZAMBIA	53	N/A	53
ZIMBABWE	118	0	118
KENYA	10	0	10
UGANDA	0	0	0
ETHIOPIA	220	0	220
TANZANIA	25	0	25
TOTAL	**426**	**0**	**426**



MLN-Free Seed production Objectives

To accomplish these objectives our Partners AATF and AGRA had the following activities;

- On-farm farmer and seed company visits to ascertain the status of MLN disease and monitor implementation of harmonized MLN management checklists.
- Training of stakeholder on the use of the checklists
- Promotion of MLN tolerant maize varieties during field days and other forums for uptake .
- Various (IEC) materials on MLN disease management and MLN –Free seed production were distributed to stakeholders in MLN endemic countries.

Note : A total of 574 participants from NPPOs and NARS institutions,
544 participants from commercial seed companies, and
2313 small-scale contract seed growers in eastern Africa were trained during 2016–2019 on the SOPs for MLN pathogen free seed production.
The course content included on-farm MLN diagnostics, disease scouting, leaf and seed sampling, and testing using immunostrips and ELISA.

Producing MLN free seeds using Harmonized Checklists

- Harmonized checklists for MLN-free commercial seed production have been finalized for Kenya, Tanzania, Ethiopia and Uganda-Rwanda

MLN MANAGEMENT CHECKLIST & SOPs

TASK	STATUS	START DATE	DUE DATE	% COMPLETE	DONE?	NOTES
Seed Dressing	Deferred			50%		
Field sanitation/Rogueing symptomatic plants						
Use border rows between plantings						
Eliminate grasses and other weeds from fields and plot borders.						
Scout for viral symptoms						
Sample suspect plants for diagnostic testing.						
Disinfect leaf punchers after sampling each plant						
Monitor and controlling insect vector population						
Eliminate grasses and other weeds from fields and plot borders.						
Harvest only non-infested/non symptomatic plants.						
Dry seed below 15% moisture before shipping or replanting						
Seed Testing						
Crop rotations						

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Develop and dissemination of appropriate communication materials on specific topics

- The MLN Web Portal post card updated with summary of achievements in MLN management efforts and distributed
- The project brief (Fact sheet) updated developed and distributed to various interest groups
- MLN Management materials development and distributed AATF/AGRA. Translated in Kiswahili and Amharic
- Development of the MLN catalogue in progress
- Development of MLN management handbook.

English

Kswahili

Amharic

Spanish

MLN free seed production activities achievements

Year	No. of Seed company on farm visits	No. of Seed Farmer on farm visits	No. of field days facilitated and attended	Number NARS Programs and Seed Companies involved in MLN Tolerant Variety Promotion	Number of Stakeholders Trained on Rapid Diagnostics	Number of IEC Materials Developed and Distributed
2016	-	-	-	-	-	11,000
2017	38	225	1	13	55	8,200
2018	35	336	3	21	60	6'000
2019	52 (45 AGRA)	125	1	12	80	4,100
TOTAL	170	686	4	46	195	29,300

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Ensuring MLN pathogen-free commercial seed production and exchange

- Intensive efforts are being made to prevent spread of MLN, especially MCMV, through contaminated seed from the MLN-endemic to non-endemic areas in Africa
- Several seed companies now implementing **voluntary MCMV control programs** and SOPs to minimize the risk of seed transmission
- **Key staff of both public and private sector institutions trained** on MLN diagnostics and management

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Capacity Building to Partners

- Regular training to all NPPO's, private company staff and NARS staff on carrying out MLN survey.
- Regular technical back stopping for all the partners for successful survey.

ODK App practical use - Naivasha

Sampling demonstration

Seed testing training at Harare

Country	NPPOs				Seed companies				Research institutions				Seed Growers			
	2016	2017	2018	2019	2016	2017	2018	2019	2016	2017	2018	2019	2016	2017	2018	2019
Kenya	12	28	35	25	22	68	25	6	12	25	12	8	68	260	230	121
Uganda	8	15	22	8	12	35	25	11	5	12	5	8	45	150	158	89
Tanzania	8	18	28	21	15	32	68	6	4	8	6	13	33	60	320	78
Ethiopia	8	12	18	47	18	61	18	12	5	18	12	16	28	93	335	125
Rwanda	2	14	55	67	12	21	13	8	7	13	28	21	23	125	138	225
Malawi	12	8	2	13	3	16	4	2	5	4	4	12	14	21	35	-
Zambia	18	18	3	12	4	25	5	3	4	6	12	4	18	28	45	-
Zimbabwe	13	12	8	4	4	32	6	2	4	8	8	3	22	32	32	-
TOTAL	**81**	**125**	**171**	**197**	**90**	**290**	**164**	**50**	**46**	**94**	**87**	**85**	**251**	**769**	**1,293**	**638**
				574				**444**				**227**				**2,258**

Training on MLN Surveillance and testing

Sampling demonstration -

ODK App practical use - Naivasha

Testing using Immunostrips

MLN Symptom Identification

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Training sessions

Community of Practice

COP Outcomes

- Increased MLN knowledge sharing amongst stakeholders in SSA
- Harmonization of surveillance and Diagnostics protocols in SSA
- Adoption of rapid diagnostics using immunostrips by seed companies and NARs

Objectives of CoP:

a) to identify, gather, and **seek agreement on the phytosanitary community requirements**, especially for effective control of MLN in SSA.

b) to provide a forum/platform for **cooperation on activities** where the CoP adds value to the existing initiatives;

c) to **share learning across borders on key aspects**, such as standardized MLN diagnostics procedure(s), providing training on MLN diagnostics, expediting adoption of appropriate phytosanitary and diagnostic procedures, identifying/validating and deploying novel and low-cost MLN diagnostic protocols, etc.

d) to **identify linkages and opportunities** for collaborative strategic and technical projects related to MLN phytosanitation and diagnostics in SSA;

e) to **report on progress and provide updates** of the projects and programs that have phytosanitary, and diagnostics components related to MLN;

f) to **provide information** for the review of maize seed certification and import/export procedures in relation to MLN for formulation of appropriate SOPs.

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Regional meetings organization and participation

- East African Community(EAC) / CIMMYT organized a regional MLN meeting on 22nd to 24th May 2018 in Nairobi where 28 participants attended.
- Training workshop on MLN free seed SOPs and rapid MLN field diagnostics – KEPHIS on 30th – 31st July 2018.

East African Community (EAC) Meeting

KEPHIS Meeting

MLN Information Portal

mln.cimmyt.org

HOME | MLN OVERVIEW | MLN RESEARCH | SURVEILLANCE | MLN SCREENING | NEWS AND MEDIA | COMMUNITY OF PRACTICE | RESOURCES

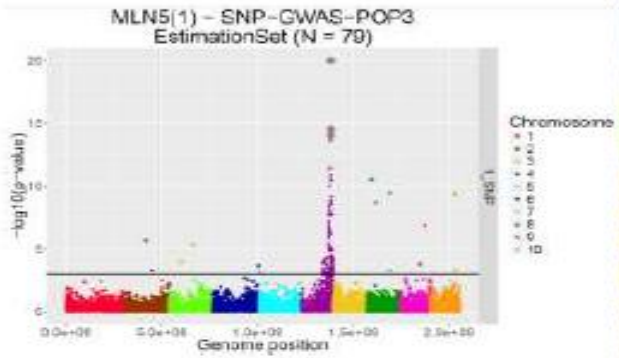
search...

MLN in the news

- Deadly virus threatening maize
- Maize Lethal Necrosis: Possible threat to local maize production
- New facility to help Zimbabwe deliver healthy seeds
- Zimbabwe: Government unveils crop disease quarantine

Genome Editing for MLN Resistance

Work in Progress



Fine-mapping of chr.6 QTL in several mapping populations during 2018-2020

- **Fine-mapping, cloning and editing** the causal genomic region(s) for MLN resistance.
- **Establishing a pipeline to edit for MLN resistance** in MLN-susceptible lines that are parents of CIMMYT-derived commercial maize hybrids in Africa.
- **Strengthening the capacity for genome editing**

BILL & MELINDA GATES foundation | CIMMYT International Maize and Wheat Improvement Center | CORTEVA agriscience | KALRO | USDA United States Department of Agriculture Agricultural Research Service

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Summary

- MLN disease in eastern Africa is in control, with constant survilense, better quarantine measures, host free period, producing MLN disease free seeds
- Southern Africa is maintained free of MLN with safe exchange of MLN free seeds and emergency preparedness is ready
- Focus on MLN resistance breeding using various novel tools, technologies and deployment of MLN resistance hybrids in eastern Africa.
- Strong private and public partnership on producing MLN free seeds and MLN disease management

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Review

Maize lethal necrosis (MLN): Efforts toward containing the spread and impact of a devastating transboundary disease in sub-Saharan Africa

Prasanna Boddupalli[a,*], L.M. Suresh[a], Francis Mwatuni[a], Yoseph Beyene[a], Dan Makumbi[a], Manje Gowda[a], Mike Olsen[a], David Hodson[b], Mosisa Worku[a], Monica Mezzalama[b,1], Terence Molnar[b], Kanwarpal S. Dhugga[b], Anne Wangai[c], Lilian Gichuru[d], Samuel Angwenyi[e], Yoseph Alemayehu[f], Jens Grønbech Hansen[g], Poul Lassen[g]

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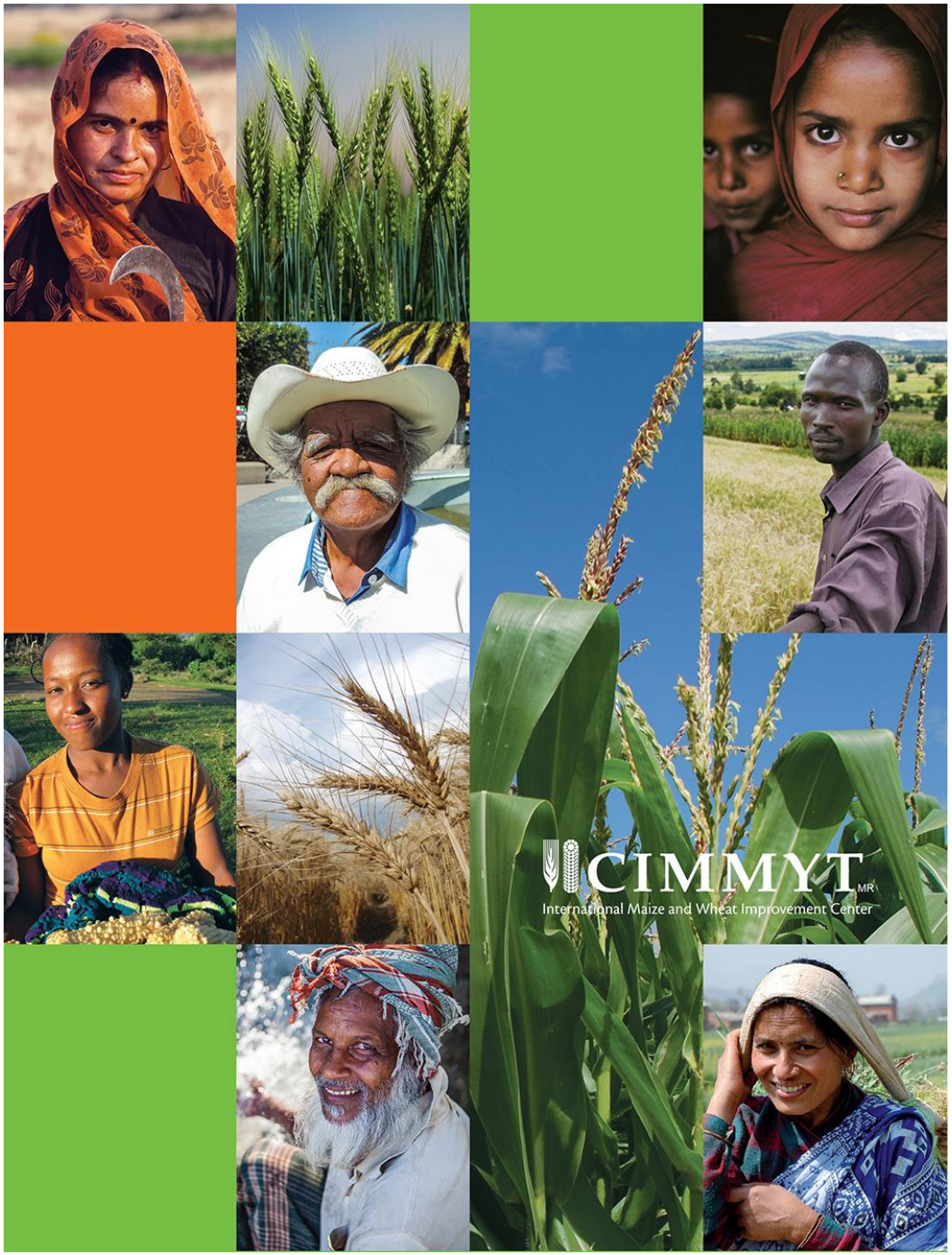

Thank you for your interest!