Maize Lethal Necrosis (MLN) in Eastern Africa

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Introduction

• The disease has affected many farmers in the Eastern Africa region since 2012 causing yield loses between 50% - 100%.

• Kenya and Uganda declared MLN as a threat to food security in their country reports.
Introduction

• Yield reduction and the symptoms.
Viruses causing MLN

- **MCMV**
  - Maize Chlorotic Mottle Virus
- **SCMV**
  - MDMV
  - WSMV
  - (other Potyviruses)

MLN

Loss of 50% – 100%

Staple food in the region
SCMV Phylogeny
Sugarcane mosaic virus

Potyvirus

Aphids

Maize chlorotic mottle virus

Tombusvirus

Thrips

Source: University of Hawaii
MLN Challenge to Maize Production in SSA

- About 90% of the regional population depends on maize for food, labor and income.
- At the farm level, some affected farmers have experienced total crop loss.
- Residual foliage to livestock due to fears of fungal poisoning.
- In Kenya, about 60,000 hectares leading to a 10% drop of the previously estimated 2014/2015 production.
- Loses of between 15% - 20% and between 50% - 90% have been reported in Peru and USA respectively
Spread of Maize Lethal Necrosis (MLN) in eastern Africa

- S. Sudan Jan 2013
- DRC March 2014
- Rwanda Mar 2013
- Tanzania Aug 2012
- Kenya Nov 2011
- Ethiopia June 2014

Source: Aisja Frenken (FAO REOA)
MLN Distribution and Spread 2011-2016

2011: Bomet County, Kenya

Data Sources: KALRO, KEPHIS, FAO, EIAR, NARO, RAB, MARI, UCG, IITA, CIMMYT
MLN Distribution and Spread 2011-2016

2012: Kenya, Uganda, Tanzania

Data Sources: KALRO, KEPHIS, FAO, EIAR, NARO, RAB, MARI, UCG, IITA, CIMMYT
MLN Distribution and Spread 2011-2016

2013: South Sudan

Data Sources: KALRO, KEPHIS, FAO, EIAR, NARO, RAB, MARI, UCG, IITA, CIMMYT
MLN Distribution and Spread 2011-2016

2014: DRC, Rwanda, Ethiopia

Data Sources: KALRO, KEPHIS, FAO, EIAR, NARO, RAB, MARI, UCG, IITA, CIMMYT
MLN Distribution and Spread 2011-2016

2015: Expansion – Ethiopia, Tanzania

Data Sources: KALRO, KEPHIS, FAO, EIAR, NARO, RAB, MARI, UCG, IITA, CIMMYT
Current MLN mitigation strategies

• Development and deployment of MLN tolerant/resistant germplasm,

• Agronomic mitigation practices, crop rotations (especially with legumes), vector control and

• Preventing further spread of MCMV from endemic to non-endemic areas
## Screening against MLN under artificial inoculation

<table>
<thead>
<tr>
<th>Season starting</th>
<th>Location</th>
<th>Entries</th>
<th>Total Rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 2012</td>
<td>Olerai and Sunripe Farm</td>
<td>2,636</td>
<td>5,272</td>
</tr>
<tr>
<td>June 2013</td>
<td>Oleria and Marula Farms</td>
<td>8,021</td>
<td>16,042</td>
</tr>
<tr>
<td>March 2014</td>
<td>Naivasha Facility</td>
<td>19,539</td>
<td>39,078</td>
</tr>
<tr>
<td>Oct 2014</td>
<td>Naivasha Facility</td>
<td>15,322</td>
<td>20,356</td>
</tr>
<tr>
<td>Nov 2015</td>
<td>Naivasha Facility</td>
<td>17,000</td>
<td>30,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>62,518</strong></td>
<td><strong>110,748</strong></td>
</tr>
</tbody>
</table>

**Bad News:**
Close to 90% of materials screened are susceptible under artificial inoculation.

**Good News:**
At least 10% are offering tolerance/resistance to MLN.

Approximately 65% of entries are inbreds
Aerial View of MLN Screening Facility at Naivasha
MLN Screening Facility established by CIMMYT-KALRO at Naivasha, Kenya
## MLN Phenotyping Service to Partners (2015-16)

### Source of germplasm

<table>
<thead>
<tr>
<th>Source of germplasm</th>
<th># of germplasm entries</th>
<th># of rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARS in SSA</td>
<td>2568</td>
<td>5144</td>
</tr>
<tr>
<td>Private sector</td>
<td>3651</td>
<td>4390</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,219</strong></td>
<td><strong>9,534</strong></td>
</tr>
</tbody>
</table>

### Private Sector

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SeedCo</td>
</tr>
<tr>
<td>2</td>
<td>Western Seed</td>
</tr>
<tr>
<td>3</td>
<td>Pannar</td>
</tr>
<tr>
<td>4</td>
<td>Monsanto</td>
</tr>
<tr>
<td>5</td>
<td>Pioneer</td>
</tr>
<tr>
<td>6</td>
<td>NASECO</td>
</tr>
<tr>
<td>7</td>
<td>Syngenta</td>
</tr>
<tr>
<td>8</td>
<td>Tanseed</td>
</tr>
<tr>
<td>9</td>
<td>Gicheha Farm</td>
</tr>
<tr>
<td>10</td>
<td>Victoria Seed</td>
</tr>
</tbody>
</table>

### Public Sector

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KALRO-Kenya</td>
</tr>
<tr>
<td>2</td>
<td>EIAR-Ethiopia</td>
</tr>
<tr>
<td>3</td>
<td>ZARI-Zambia</td>
</tr>
<tr>
<td>4</td>
<td>RAB-Rwanda</td>
</tr>
<tr>
<td>5</td>
<td>KEPHIS</td>
</tr>
<tr>
<td>6</td>
<td>Makerere Univ.</td>
</tr>
<tr>
<td>7</td>
<td>NARS-South Sudan</td>
</tr>
</tbody>
</table>

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CIMMYT
First-generation MLN-tolerant hybrids released and being scaled-up for delivery to farmers in eastern Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>Variety</th>
<th>Released by</th>
<th>Seed company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>UH5354</td>
<td>NARO</td>
<td>NASECO</td>
</tr>
<tr>
<td>Kenya</td>
<td>H12ML</td>
<td>KSC</td>
<td>KSC</td>
</tr>
<tr>
<td>Tanzania</td>
<td>HB607</td>
<td>Meru-Agro</td>
<td>Meru-Agro</td>
</tr>
</tbody>
</table>

5 more MLN-tolerant hybrids recently recommended for release in Kenya.
2nd generation MLN Resistant Hybrids (Naivasha; 2016)

11 second-generation CIMMYT-derived MLN resistant hybrids presently under NPTs in Kenya, Tanzania and Uganda.
MLN Resistant Hybrids versus Susceptible Checks
Under high natural disease pressure in Tanzania

Yield advantage of at least 3-4 t/ha for MLN tolerant hybrids (with a score of 1.0-2.0) under high MLN pressure in farmers’ fields (in Tanzania), as compared to MLN-susceptible commercial checks (with a score of >3.5) yielding 0 to <1.0 t/ha.
USAID MLN Diagnostics and Management Project

Controlling the Spread and Impact of MLN in SSA

- 4 years (Oct 2015 – Sept 2019)
- CIMMYT, NPPOs in ESA, AGRA & AATF, in active interface with the commercial seed sector

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.
Need to control the spread and impact of MLN in sub-Saharan Africa

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

MLN-endemic countries

Non-endemic countries

Project Implementation Areas
Effective MLN surveillance and monitoring using harmonized protocols

• Maintaining effective surveillance programs in farmers’ fields as well as seed production fields in MLN endemic countries

• Maintaining effective surveillance programs at point of grain entries in non-endemic countries

• Preventing the spread of the MLN pathogens, especially MCMV from MLN-endemic to non-endemic countries
Enabling Tools & Technologies: survey + sampling

Traditional

• GPS + Paper forms
• Manual data entry

New Options

• Smartphone / tablets (GPS, Camera, Electronic Form, Barcode scanner)
• Automatic data transfer

Standardized geo-referenced field surveys across countries
Field to database now possible in near real-time
Electronic Survey Tool

- Developed using ODK
- Functional on any Android device
- Quality controlled data input
- Incorporates: GPS, photos, barcode scanning of sample labels
- Direct transfer to central Dbases
MLN Surveillance and testing in Zambia – April 2016

MLN Surveillance map - Zambia
MLN surveillance in farmers’ fields - Uganda

Sampling demonstration
Affordable, reliable and user-friendly diagnostics options for MLN

• User-friendly, simple-to-use, cost-effective, robust, and rapid as well as a long shelf life and appropriate specificity

• Besides seed growers and producers, rapid and easy-to-use pathogen MLN pathogen detection methods are also needed by regulatory agencies, exporters, importers, and extension agents.

• Sampling schemes and economic thresholds need to be established to effectively minimize MLN pathogen spread without negatively impacting maize trade.
MLN Diagnostics protocols
Training on MLN Surveillance and testing

Sampling demonstration -

Testing using Immunostrips

ODK App practical use - Naivasha

MLN Symptom Identification
Establishing an MLN Disease Surveillance and Monitoring System in eastern Africa

- **MLN Web Portal** - provides latest updates on disease status in different countries, promising MLN tolerant varieties, and MLN management recommendations – to be linked with appropriate knowledge hubs of the Ministries/NPPOs, regional organizations, etc.

- **Capacity building of the NPPOs on MLN surveillance and data management**, for sustainable contribution to the network
MLN Toolbox Overview

- MLN toolbox – Not public. Only for partners and data providers – after login
**MLN Web Portal**

**Aim:** Single source of up-to-date information for MLN monitoring and surveillance in Africa
- Linked directly to MLN Toolbox
- Dynamic tools – Toolbox driven
- Modelled on [www.rusttracker.cimmyt.org](http://www.rusttracker.cimmyt.org)

+ possible alerts / early warning
Early Warning / Forecasting

- Being undertaken in Collaboration with Cambridge University
-- Modelled on the Wheat Stem Rust System

Risk + Hazard Maps
Optimizing surveys + Sampling
Insect Vector Dispersal???
Ensuring MLN-free seed production and exchange

- Immediate steps must be taken to prevent further spread of MLN, especially MCMV, through contaminated seed from the MLN-endemic to non-endemic areas in Africa.
- Seed companies should implement voluntary MCMV control programs and SOPs to minimize the risk of seed transmission.
- Identify and maintain MLN disease-free seed production zones.
- Training key staff on MLN management and diagnostics.
- Evaluate the presence of MCMV in commercial seed lots meant for exportation to countries where MLN/MCMV is reportedly absent.
Harmonized Checklists

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

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

NAME: ___________________________________________  POSITION: _______________________

ORGANISATION: _______________________________________

SIGNATURE: ________________________________________

- Training and monitoring on the use of the SOPs and the Checklist in Y2
Training seed growers on use of Checklists
Pekerra Irrigation Scheme – Kenya
The CoP membership is currently 32
The CoP enables close interaction by all the members on the common goal of tackling the MLN menace in SSA.
A CoP communication platform has been developed - Google groups (email based and launched 2016)
A WhatsApp Platform is also available and active
Acknowledgements

- USAID, Bill & Melinda Gates Foundation, SFSA and CRP MAIZE, for supporting the work on MLN
- KALRO, NARES and Private sector partners
- NPPOs of 8 Participating countries, USAID – MLN Project
- CIMMYT-Africa Team involved in the USAID-MLN Project
Thank you for your interest!

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