General methods for reducing seed contamination by MLN viruses

Global Maize Program

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CIMMYT- Kenya

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USAID-MLN Diagnostics and Management Project

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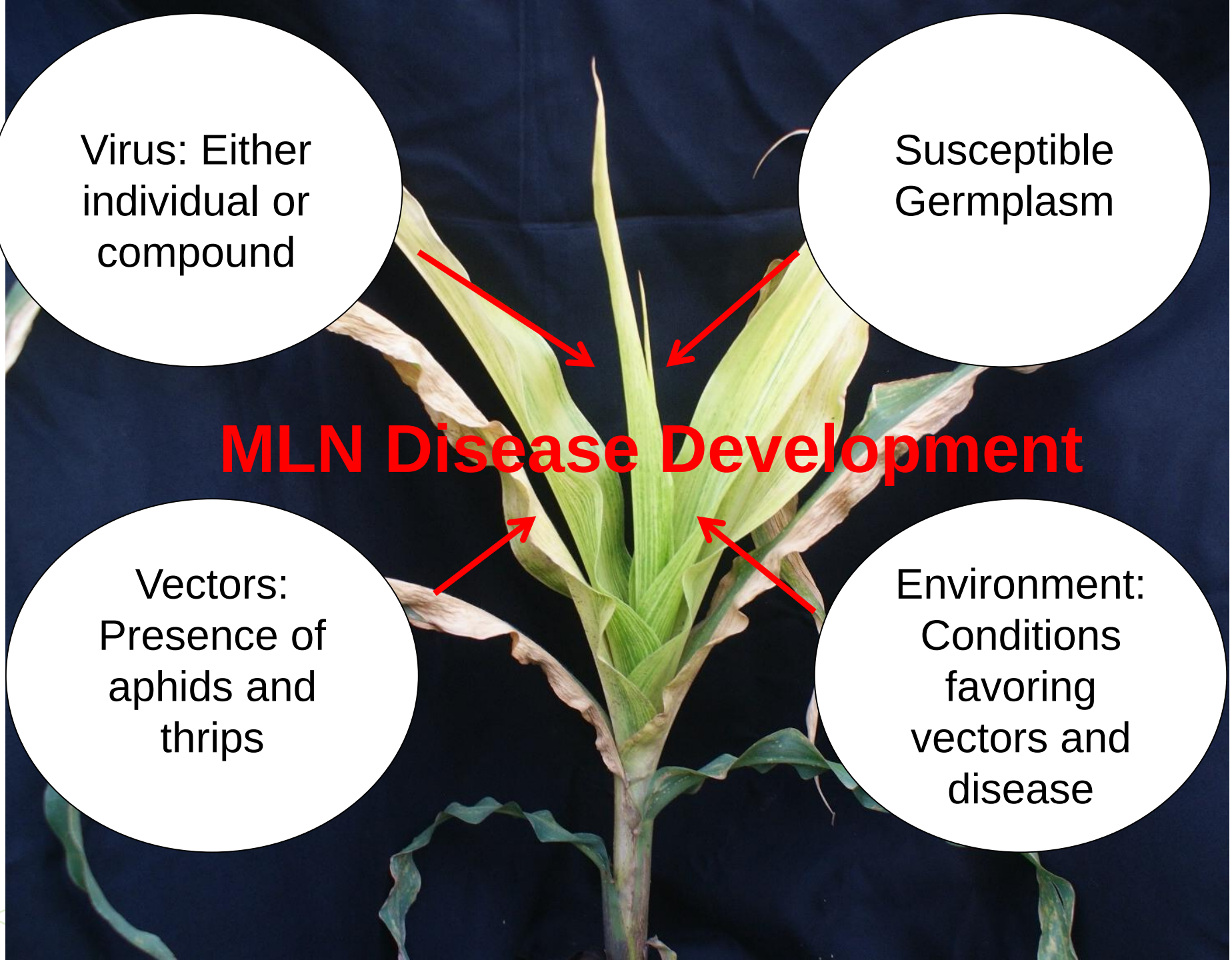
Virus: Either individual or compound
Susceptible Germplasm
MLN Disease Development
Vectors: Presence of aphids and thrips
Environment: Conditions favoring vectors and disease

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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Why is the MLN devastating in EA?

- MCMV is new to the region
- Potentially new strains of SCMV/MDMV
- Widespread cultivation of susceptible germplasm that has never been screened for MCMV

- Characterization of viral populations will reveal identify of strains in the region.

Disease Symptoms

- 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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Symptoms of the disease

- Symptoms observed vary widely depending on;

  -Germplasm

  -Time of infection

  -Prevailing environmental conditions

  -Ratios of the viruses infecting the plant

- The symptoms can easily be confused with drought , micro- nutrient deficiency or stalk borer infestation

Symptoms in artificially inoculated maize plants in screen house

MCMV

SCMV

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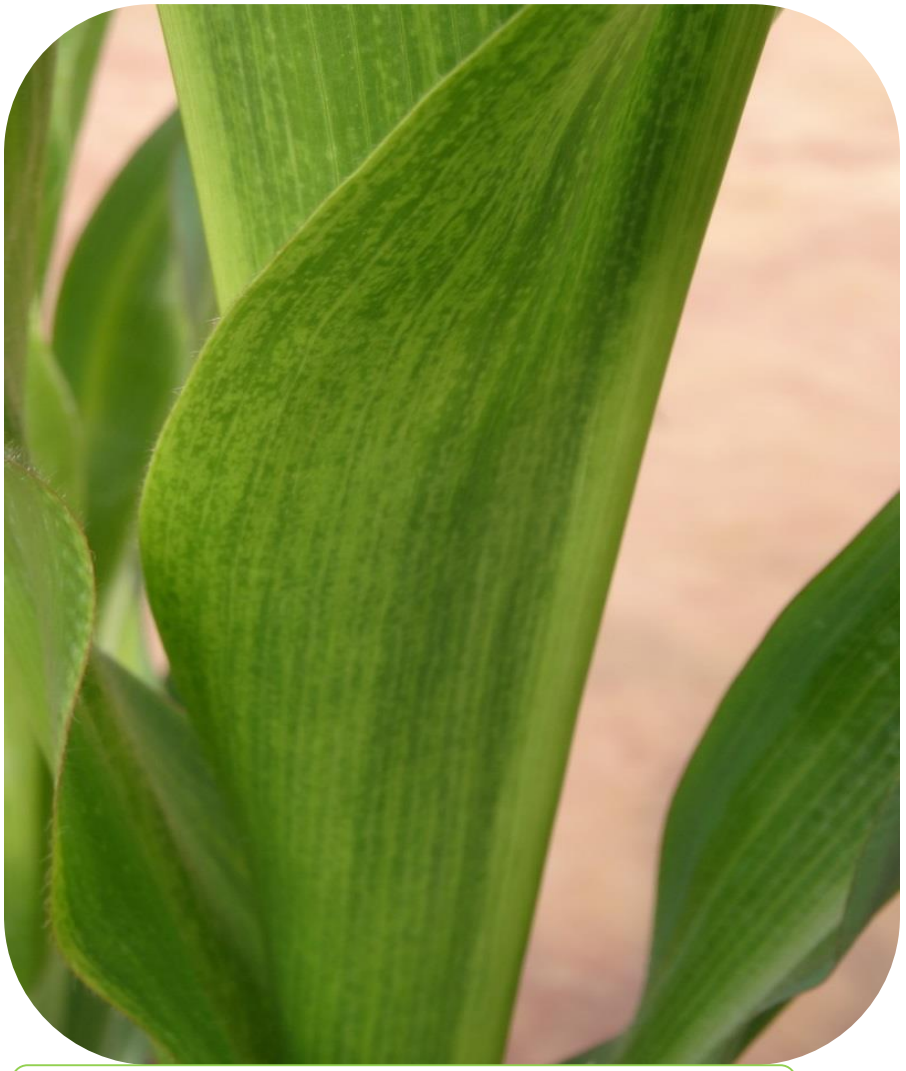
Early Symptoms

Mild mosaic and mottling

Mild mosaic and mottling

Early MLN Symptoms

Chlorosis and Mottling



Diffuse mottling and chlorosis

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Severe chlorosis and leaf necrosis

Shortened internodes and severe chlorotic mottle

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‘Dead Heart’ symptoms

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Premature drying of the husks

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Poor or no grain filling

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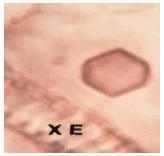
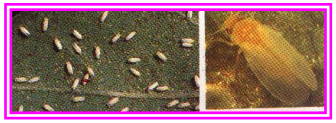
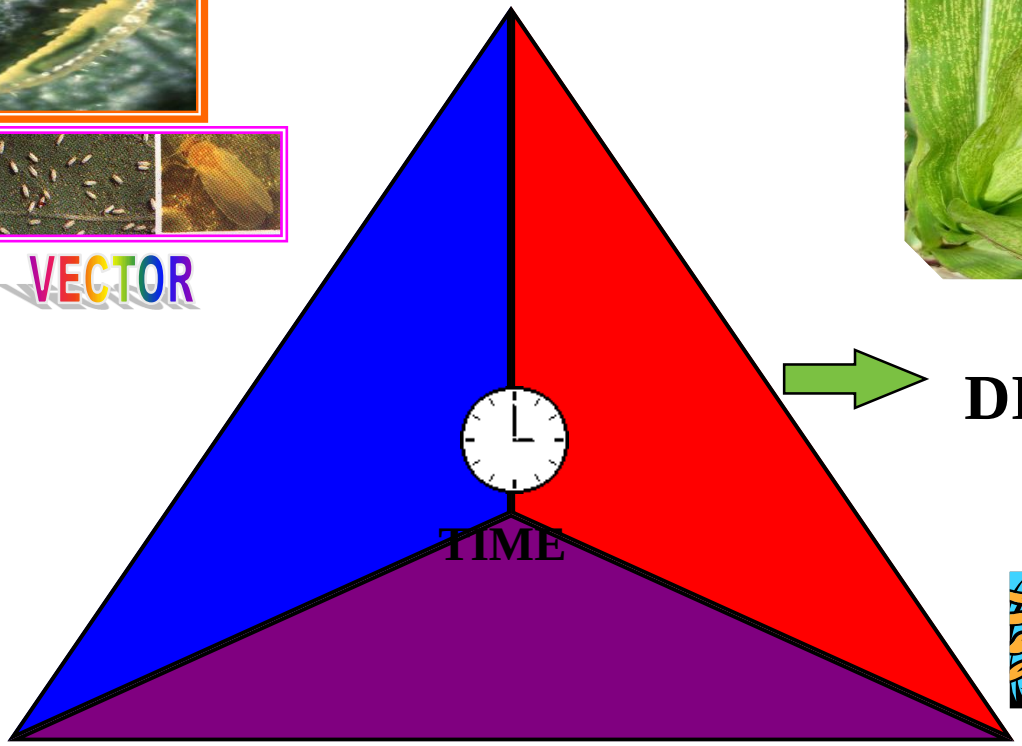


VIRULANT PATHOGEN



VECTOR

SUSCEPTIBLE HOST



DISEASE

CONGENIAL ENVIRONMENT

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Management Strategies of Viral Diseases

Avoidance:

- Plant a maize in such location where the virus or vector is not present.
- Time planting so that plants are at a less susceptible growth stages when the virus and the vectors is present.

Exclusion

- Impose quarantine (local and international)
- Use virus free seeds

Eradication:

Use herbicides to kill the weed hosts.
Rogue infected plants.
Use insecticides to kill vectors

Protection

Mandate crop free periods
Plant barrier crops.
Apply insecticide
Plant MLN resistant or tolerant maize cultivars.

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Avoidance :

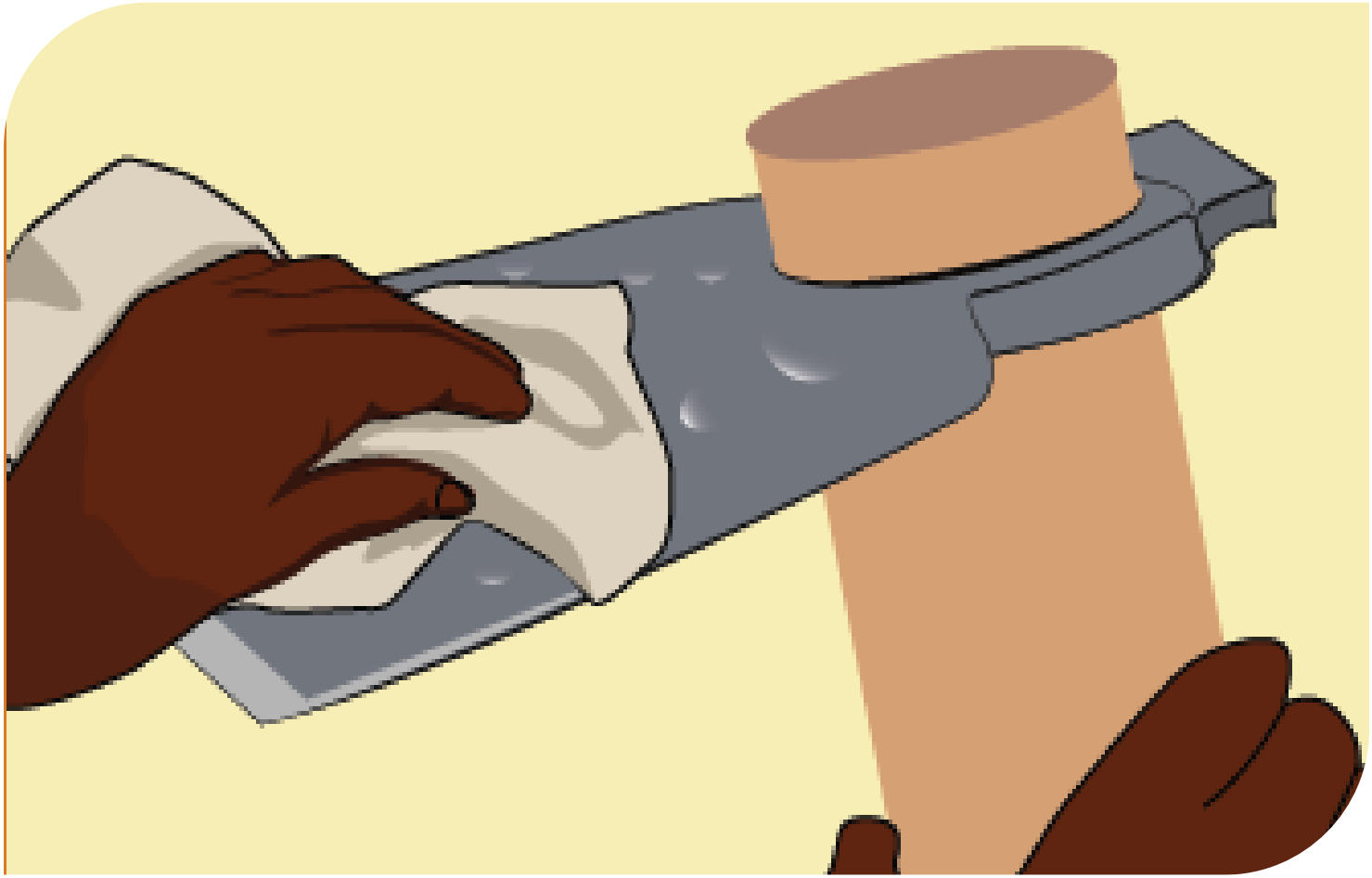
- ✓ Avoid visiting your maize field once in contact with any MLN affected maize field.

Avoidance

- ✓ Don’t feed infected MLN plants to livestock (cattle, sheep, goat., etc.,)

Avoidance :

Use clean tools and equipment's during cultivation



✓ Keep your farm equipment clean and disinfect after and before use.

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Avoidance
Community of Practice (CoP)

- ✓ Discuss within community and get common solution in consultation with the ministry of agriculture

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Avoidance:
Disease free certified seeds

✓ Use certified seeds from a reputed seed agency or a seed company

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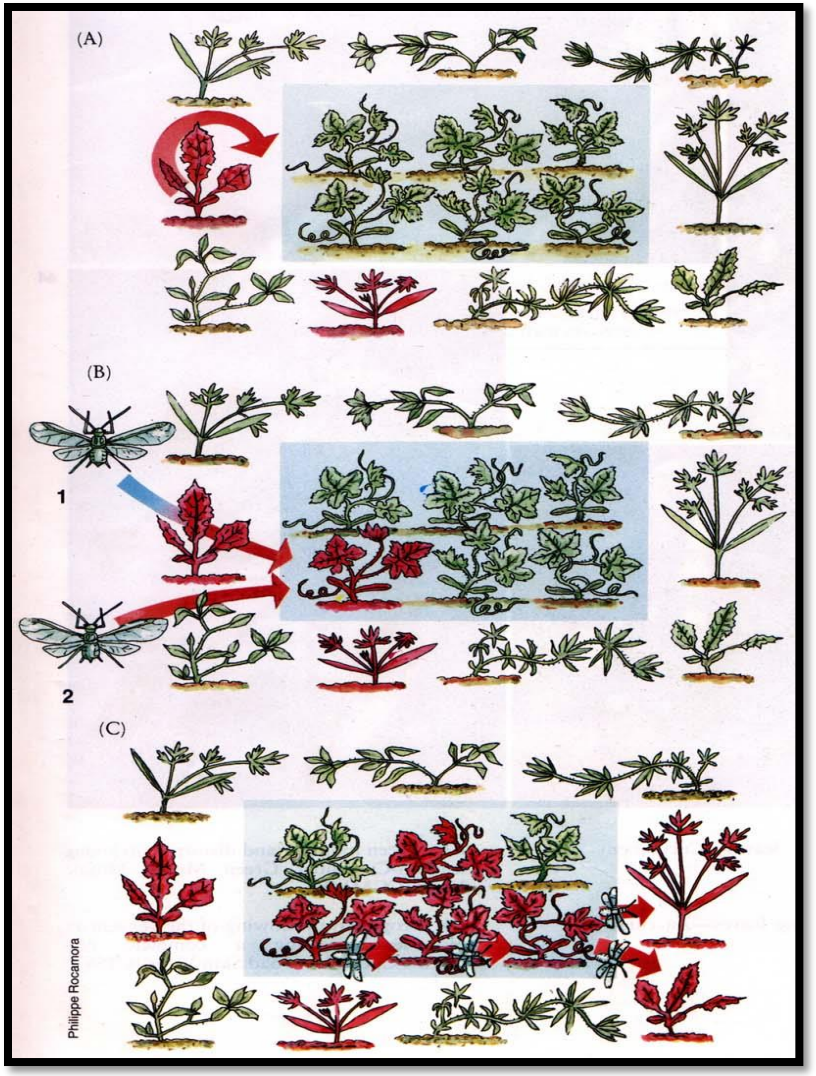
Avoidance

- ✓ Do not use seeds from MLN / MCMV infected maize plants

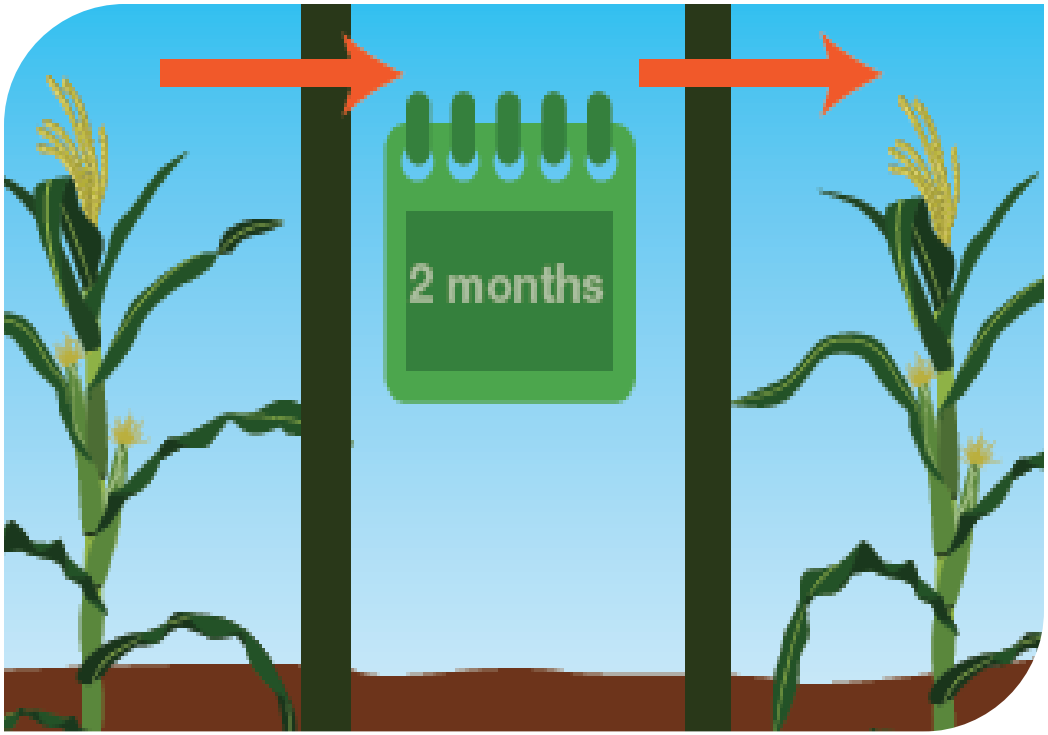
Exclusion



- ✓ Remove the weed host and alternate host before and during the crop cultivation

Exclusion

Maize free period



- ✓ Avoid growing maize up to 2 months

Exclusion:
Crop Rotation

- Grow non-maize crop like legumes after the maize crop to avoid regular MLN host.

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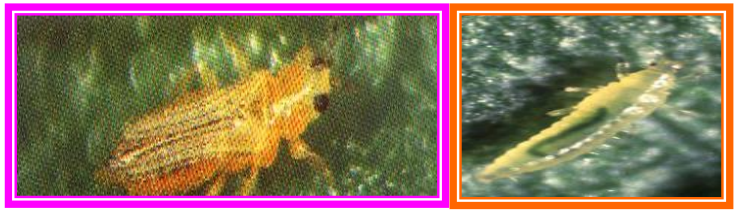
SUCKING PESTS ROLE



Aphids

Thrips

Whitefly

Transmits Viruses

Sucking Pests

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Eradication

Insect vector management

- It is very important to spray suspected or infected field with systemic insecticide in consultation with your local ministry of agriculture.

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Eradication:
Rogue the suspected MLN plants

- Rogue the infected plants and burn them
  - Rogue the plant during evening hours after pesticide spray.

Seed treatment using Chemical

- The virus transmitted as an external source of contamination would serve as source of primary inoculum and hence create many epiphytotic.
- The purpose of seed disinfestation is to kill pathogens living on the surface of the seed without actually affecting the vigour and viability, of the seed.
- Transmission of maize chlorotic mosaic virus on maize seed can be eliminated by soaking seeds in a solution of a tri-sodium phosphate (10%).
- Initial encouraging result showed significant effect on elimination of virus on maize seeds.
- Large scale protocol harmonization is in progress

Aerial View of MLN Screening Facility at Naivasha

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MLN Screening Facility established by CIMMYT-KALRO at Naivasha, Kenya

MLN Phenotyping at a Glance - 2014 to till date

Season	CIMMYT		NARS		Seed companies	
	Entries	Rows	Entries	Rows	Entries	Rows
2014A	15712	32807	3409	6761	5594	9226
2014B	10003	20047	1724	3866	4827	7876
2015B	7022	10284	3372	5077	3263	4038
2016A	12335	19703	6785	6785	5410	7734
2016B	11454	13834	4128	6006	4807	5005
2017A	9046	16938	2671	3379	1569	4285
2017B*	7128	7128	1909	2488	2593	2593
Total	**72700**	**120741**	**23998**	**34362**	**28063**	**40757**

Season Starting Total	Location	Entries*	Total Rows
Nov-12	Olerai and Sunripe Farm	2,636	5,272
Jun-13	Olerai and Marula Farm	8,021	16,042
Mar-14	Naivasha Facility	19,539	39,078
Oct-14	Naivasha Facility	15,322	20,356
Nov-15	Naivasha Facility	17,000	30,000
May-16	Naivasha Facility	24,530	34,222
Oct-16	Naivasha Facility	20,389	24,845
May-17	Naivasha Facility	13286	24602
Nov-17	Naivasha Facility	11630	12209
	Total	**132,353**	**206,626**

Organization Type	Total number of entries	Total Rows	% of Rows
Public	23998	34362	17.54
Private	28063	40757	20.81
CIMMYT	72700	120741	61.65
Total *	**124,761**	**195,860**	

Private Partner
Monsanto
Seedco
Dupont - Pioneer
East Africa seed company
Western Seed
Syngenta
Kenya Seed
NASECO
Pannar Seeds
Advanta Seeds
ZAM Seeds
Tan seed
Aminata
Gicheha Farm
Victoria seed UG

Public Partner (Country / Organization)
KALRO - Kenya
Student - Uganda
EIAR NARO
NaCRRI - UGANDA
ZIMBABWE
Mozambique
RAB - RAWANDA
SARI - TANZANIA
University of Nairobi
KEPHIS - Kenya
South Sudan
MALAWI
Rongo University
Burundi

*** Note : updates from Naivasha ;2014 to till date**

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MLN - infected

MLN - free

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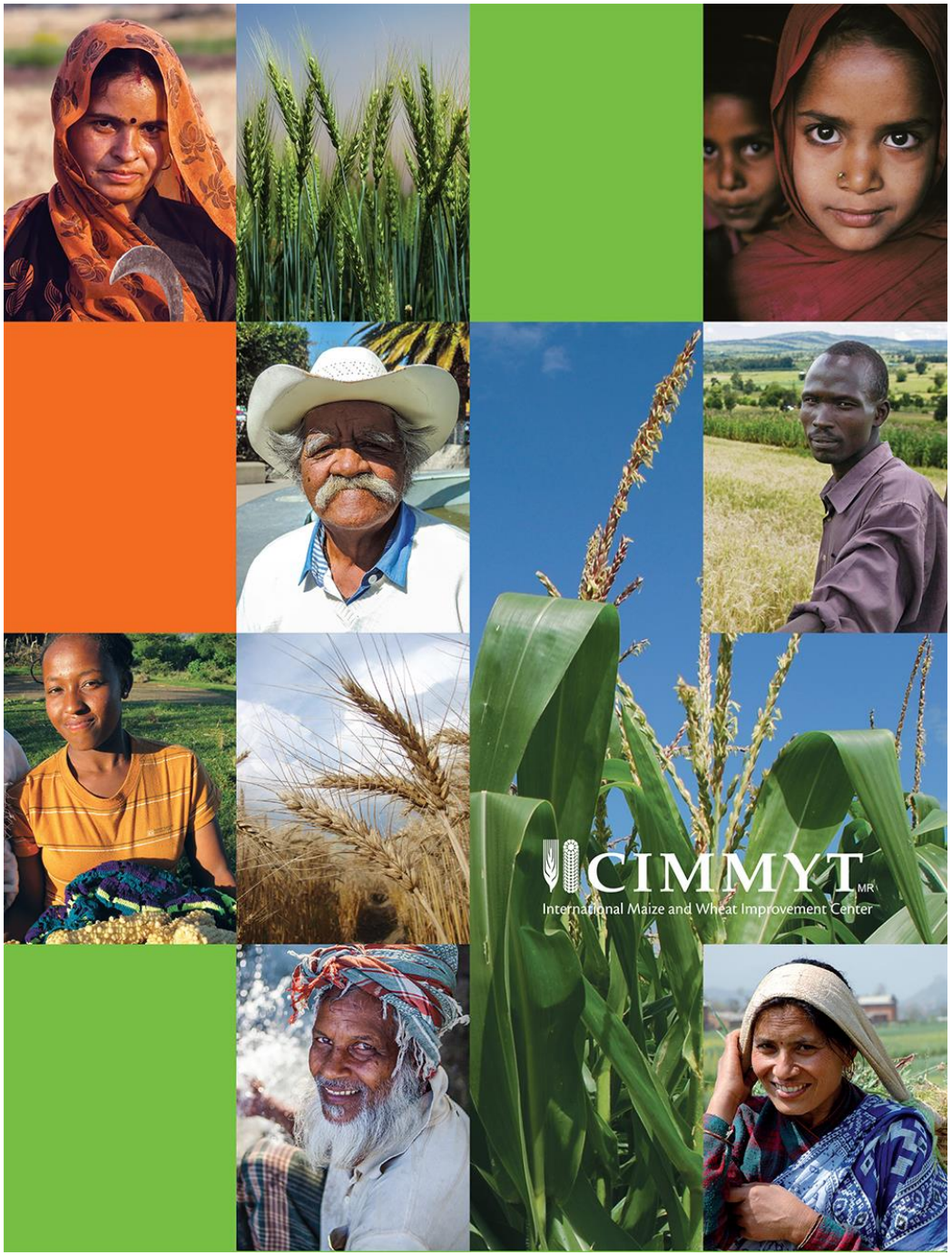

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