Update on maize diseases and their control

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Why manage diseases?

- Kenya like many African relies on Agriculture as main driver of the economy.
- Food security is one of the four pillars of development for the next five years to reduce poverty.
- Plants pests are the most common cause of reduction or destruction of plant growth and production.
- Therefore the welfare of plants is of particular interest under this pillar.
- Diseases introduced in a new area likely to cause catastrophic epidemics.
New Pests

- Many new pests come to Africa from other countries

- From 1900–2000:
  - 233 new pests were recorded, introduced from outside Africa
  - 66 of these were new insects and mites
  - 167 of these were new plant diseases
New pests and diseases of maize

- Reported new outbreaks of maize pests of epiphytotic proportions 1990–2017
- Grey leaf spot 1990’s
- Large Grain borer –1990’s
- MLND–2012
- Head smut 2016 (resurgence}
- Fall Army Worm 2017
Diseases of economic importance in the region

- Turcicum blight – (as old as the maize in Kenya)
- Cob/ Stalk rots – (as old as the maize in Kenya)
- Rusts – (as old as the maize in Kenya – 1800)
- Maize streak virus – 1912
- Grey leaf spot – 1990
- Maize lethal necrosis disease – 2012
- Head smut – (as old as the maize in Kenya – resurgence 2016)
Diseases of economic importance

- Turcicum blight and Cob/ Stalk rots, MSV, Rusts and to some extent GLS have evolved with maize in the country
- Efforts to breed/ select resistant varieties in all Kenyan breeding program are in place
- All varieties releases have to have good levels of resistance to qualify for release
- Deliberate efforts in breeding, epidemiology, regulatory framework and cropping system to manage MLND and Head smut are now in place
Turcicum blight

Symptoms

- Elliptical necrotic grey-green lesions on the leaves.
- Lesions run parallel to the leaf veins. Appear grey-sooty appearance because of mass of spores (conidia) formation.
- As the disease progresses, the lesions grow together and create large areas of dead leaf tissue.
- In susceptible corn hybrids, lesions are also found on the husk of ears or leaf sheaths.
- The disease is polycyclic – fungi may undergo many reproductive cycles in a season-favourable condition and susceptible host.
- Turcicum blight occurs in many forms that are host specific, on various grasses.
Turcicum blight symptoms

Field showing northern corn leaf blight damage
Management

- KALRO–Kakamega one of the regional centres for Turcicum blight evaluation
- National program –allows only varieties of severity rating of <2.5 for release–host resistance
- Cultural control
  - Rotating maize with non–host crops can reduce disease pressure and removal of infected crop residue.
  - Fungicides may not be cost effective particularly for grain production.
Grey leaf spot

Symptoms

- Starts as brownish and yellow, the tissue within the "spot" begins to die as spot size increases into longer, narrower leaf lesions.
- These symptoms appear on the corn husks and leaf sheaths.
- Mature corn grey leaf spot lesions have brown rectangular and vein limited shape.
- Secondary and tertiary leaf veins limit the width of the lesion and sometimes individual lesions can combine to blight entire leaves.
GLS Symptoms on leaves
Management

- Resistant varieties
- Crop rotation
- Residue management
- Fungicides
Maize streak virus disease

symptoms

- Starts as pale spots or flecks, 0.5–2 mm in diameter. Symptomatology may vary depending on the host, cultivar or virus isolate.
- In severe cases, the initial pale spots become longer streaks which eventually coalesce.
- Maize plants infected before the 4–5 leaf stage can be severely stunted.
Symptoms on the leaves and vectors
Management

- KALRO–Muguga is the National centre for MSV disease screening
- National program – allows only varieties of severity rating of <2.5 for release
Cob rots/stalk rots

Major cob rots in the region

- Diplodia rot
- Fusarium rots – Both *F. graminearum* and *F. moniliforme* and associated mycotoxins are of concern
- Aspergillus rots – associated with post harvest handling and of concern because of aflatoxin
Head smut

- This an example of a disease that has shown resurgence in the recent past.
- Little research attention because of previous very incidence
- Sporadic but high incidence recorded in Nandi and Uasin Gishu counties
Infection

- Infection by smut fungi starts in the soil, the fungi grows silently through the plant during the growing season without exhibiting distinct symptoms. The typical symptoms/sign are exhibited at flowering when masses of black fungi explode through the cobs and tassels.

Symptoms

tassels and ears are colonized by the fungi resulting in a mass of black fungal spores. In severe cases most plants will be sterile without any symptoms. The mass of spores may also be on leaves.
Head smut of maize

Colonization of the tassels and the cobs
Head smut

Desperate attempt by a farmer to remove the affected plants

Poorly managed farms are most affected
Recommended cultural practices

- It is recommended that to have deep ploughing, destruction of infected plants and crop rotation as control practices.
- Water stress early in the season 3–4 weeks may result in heavy infection.
- Planting dates may have no effect on disease incidence but may be related to availability of moisture during the growing season.
- Proper crop husbandry that minimizes crop stress.
- Feeding of animals on affected plants should be avoided because of the ability of the spores to survive through the gut of the animals and back to the soil though cow dung and manure.
Maize Lethal Necrosis Disease

Disease Identification

Maize Lethal Necrosis (MLN) Disease
Maize chlorotic mottle viruses (MCMV)
AND
Sugarcane mosaic virus (SCMV)

OR any other cereal virus in the Potyvirus group
(eg. Maize mottle virus –MMV and Wheat streak virus–WSV ).
Sugarcane mosaic virus

How is SCMV transmitted

- Mechanical
- Insects
  - Aphids
- Seed transmission rates – very low rates

SCMV = 21/72,897 plants (0.03 %)
Maize Chlorotic Mottle virus- (MCMV)

How is MCMV transmitted

- Mechanical
- Insects
  - Corn thrips
  - Cereal leaf beetle
- Seed transmission – v. low
  - MCMV = 17/42,000 & 1/22,189 seeds (0.04%, 0.005%)
  - MDMV = 21/72,897 plants (0.03%)
SYMPTOMS

- Mild to severe mottling on the leaves, usually starting from the base of young leaves in the whorl and extending upwards toward the leaf tips.
- Stunting and premature aging of the plants.
- Dying (known as “necrosis”) of the leaf margins that progresses to the mid-rib and eventually the entire leaf.
- Necrosis of young leaves in the whorl before expansion, leading to a symptom known as “dead heart” and eventually plant death.
Plant host range for MCMV

- Maize is the only natural host reported for MCMV.
- Host range limited to the grass family - *(Poaceae)*
- Among these grasses, 73 plant species in 35 genera have tested susceptible to MCMV
Global occurrence of Maize chlorotic mottle virus (MCMV) & Sugarcane mosaic virus

**MCMV:**
- Globally, the virus was first reported to infect *Z. mays* in Peru (Hebert and Castillo 1973).
- MCMV is not widespread in the US, reported only in Nebraska, Kansas, and Hawai.
- Occurs in Argentina, Mexico, and Peru.
- The virus occurrence first reported in Kenya – May 2012

**SCMV:**
- Globally where sugarcane is grown
DISEASE EXPRESSION & SYMPTOMS

Symptom expressions depend on:

- The viruses infecting the crop
- Titer (concentration of virus) of the viruses
- Cultivar infected
- Time of infection in the crop growth
- Prevailing environmental conditions
- Agronomic factors
FIELD OBSERVATIONS
A young maize field crop infected by MLND
INFECTED VS HEALTHY
Severe chlorotic mottle on leaves
Severe mottle on the leaves
‘Dead Heart’ symptoms
Infection at germination stage
Tassels with no pollen & poorly filled Kernel
Husks dry prematurely, no grain
Creation of Awareness

Created public awareness on disease and management options to Extension staff, Stakeholders, Farmers via
a) Electronic and Mass media
b) Technical Publications
c) Public Forums
d) Field days
**Plant Resistance:**
Screening of maize germplasm

**2012:** Screening trials for tolerance/resistance to MLND done in Naivasha and Bomet:
- 3/50 pre-commercial hybrids selected
- 15/200 elite hybrids selected

**2013:** Screening trials going on in Naivasha and Bomet (artificial inoculation):
- Over 2,000 lines planted in Nov/Dec.,
- Plans to plant 4,000 lines in March/April.
Recommendations

- Creation of public awareness
- Host Resistance:
  - Intensify screening of maize germplasm for tolerance/resistance to MLND
  - Initiate MLND tolerance/resistance breeding in maize improvement programs
- Review cropping practices
  - Introduction of closed maize seasons,
  - Quarantine movement, removal and disposal of infected maize crop,
  - Crop Rotation Schedules
Recommendations

- Vector management
  - Commend regime of pesticide applications for vector control (seed and foliar)

- Integrated Pest Management options
  - Genetic resistance, Vector control, Cultural, Good Agricultural Practices

- Identifying alternate hosts of viruses and vectors

- Conducting tests to verify seed transmission of viruses in local cultivars
Long term Disease Management measures

- Strategic research for tolerance/resistance
- Capacity building along value chain for disease and pest management
- Establish a system for pest and disease forecasting & early warning
- Establish a centralized data bank and backup system
- Formulate and implement conducive policies on handling of emerging pest and disease epidemics
Thank You