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Integrating approaches to reduce mycotoxin contamination of crops

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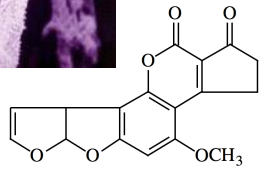
Mycotoxins


Photo: Karanja, KALRO

- Compounds produced by a range of fungi, toxic to human health
- Contaminate crops broadly
- Carry over into animal-sourced foods

Aflatoxin



- Produced by *Aspergillus* fungi
- Infect a range of crops
- Invisible/difficult to detect or sort
- Toxic to humans and animals (livestock)
  - Carcinogenic
  - Associated with
    - Stunting
    - Immunosuppression
    - Blocking nutrient absorption

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DAILY NATION

Kenya alert over 2.3m bags of bad maize

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2010 outbreak: Eastern Kenya posho mill maize survey

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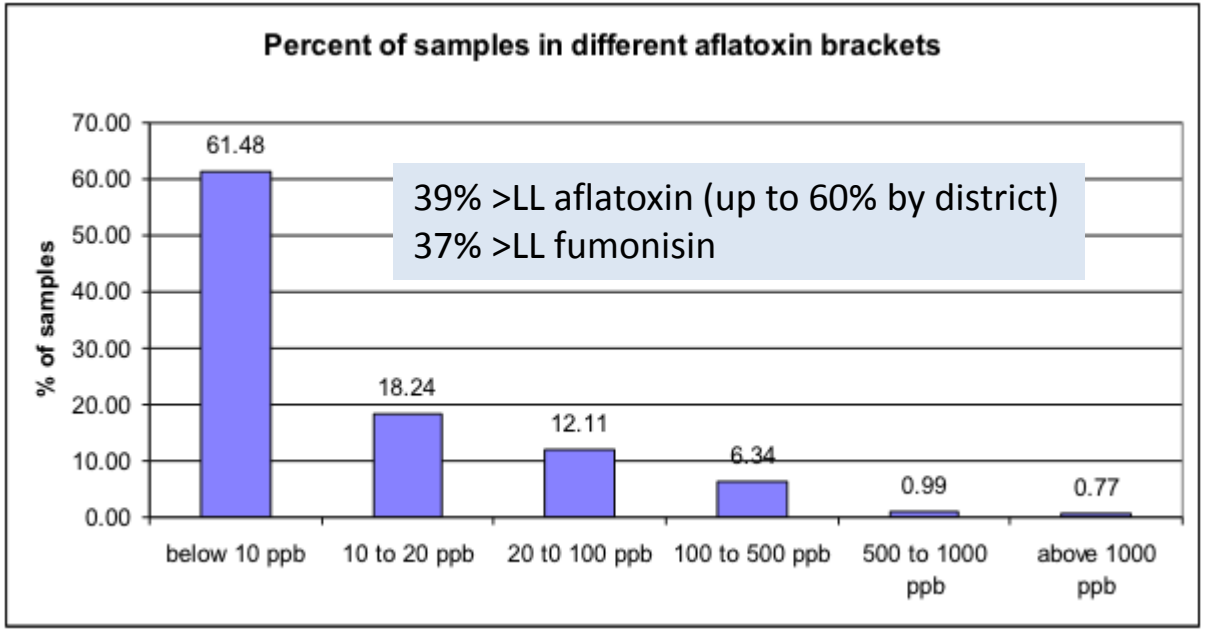

Samuel Mutiga
(Rebecca Nelson, Cornell)

Mutiga et al., 2014 *Phytopathology* 104(11): 1221-1231 (Cornell/UMd/BecA-ILRI Hub)

Aflatoxin risk: a complex set of drivers

Aflatoxin risk determined by:

Host: crop species and variety/type

x Fungal population

x Crop management in field

x *Environmental conditions*

x Postharvest practices

A broad and expanding threat

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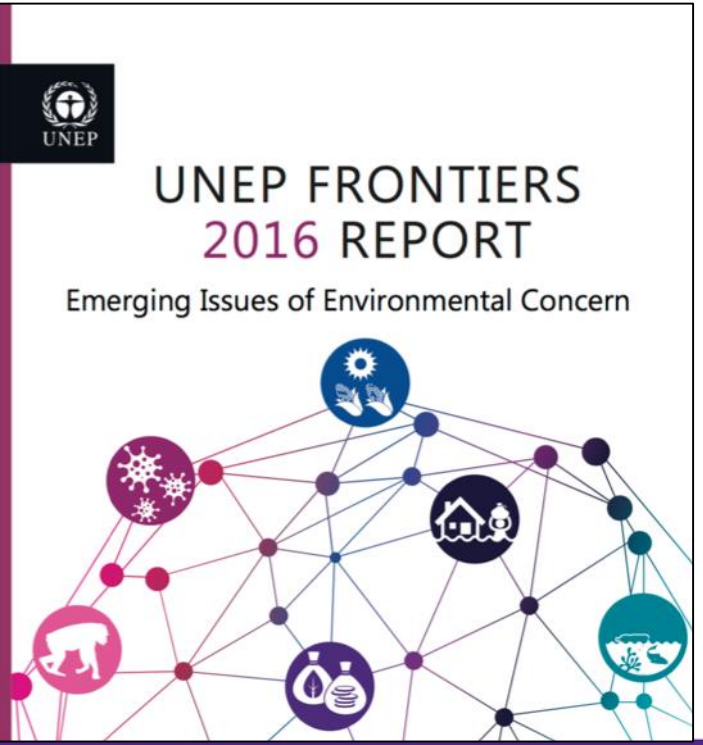

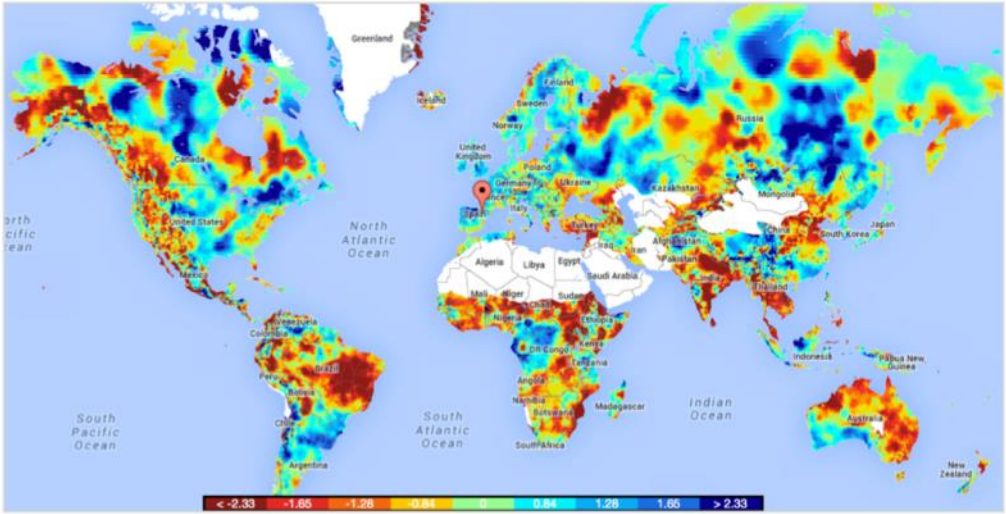

© SPEI Global Drought Monitoring
http://sac.csic.es/spei/map/maps.html

A broad and expanding threat

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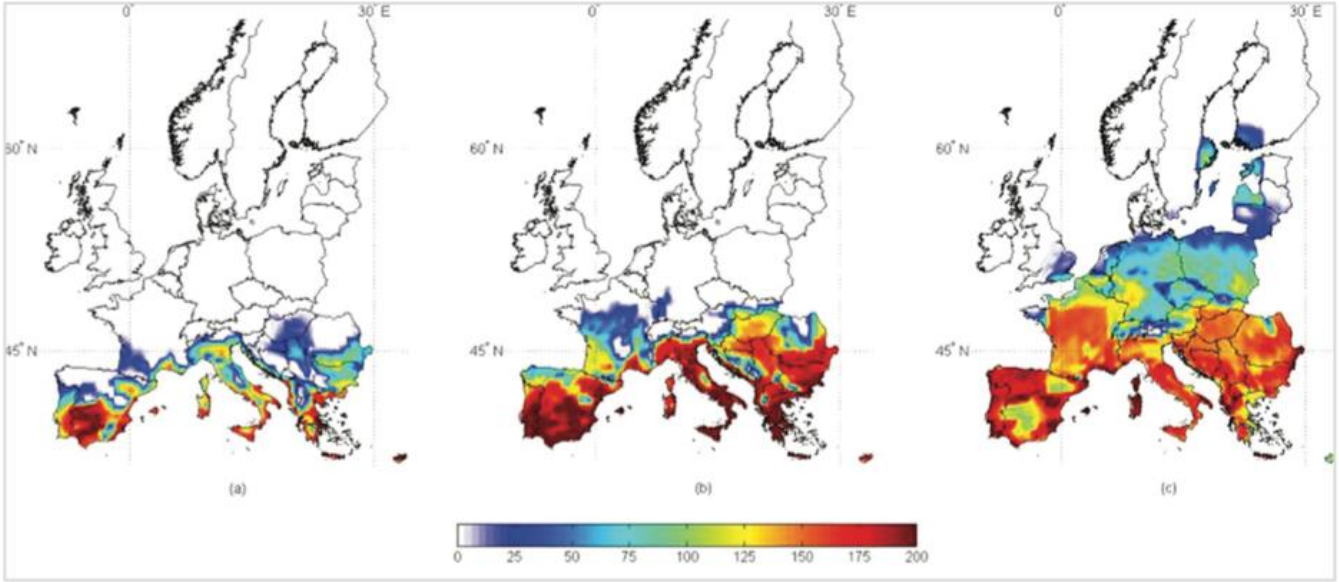
Risk maps for aflatoxin contamination in maize at harvest in 3 different climate scenarios, present, +2 °C, +5 °C



Source: Battilani *et al.* (2016)[21]
Material available under Public License, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4828719/

Addressing a complex problem

To reduce aflatoxins for all farmers and consumers, reducing risk and addressing contamination along the value chain is essential.

Targeting appropriate interventions:

Prevention – reduce risk from field to consumption

Surveillance and response – when conditions have eclipsed interventions' effective range

Integrating interventions

Preharvest:

Biocontrol: competitive exclusion

Good agricultural practices: adoption incentive includes higher yield

- Reduce biotic and abiotic crop stress (e.g., drought, nutrient stress)
- Use appropriate varieties for agroecologies
- Planting time
- Intercropping, crop rotation, tillage, fertilizer
- Planting less susceptible crops

Periharvest: harvest time, avoid soil contact

Postharvest:

adoption incentive includes reduce losses

- *Testing → decontamination and alternative uses*
- Proper drying
- Proper storage

Moisture content (measurement)

- *Testing → decontamination and alternative uses*

(Surveillance to predict hotspots near harvest time: modelling and mobile diagnostics - appropriate sampling)

Post-harvest losses

- Losses in quantity and quality, including economic losses.
- Estimated ~1/3 loss in developing countries
- Scant evidence base – weak methodologies
- Many interventions available, off the shelf or used elsewhere
- Limited focus on gender – key for development
- Limited success and impact to date *relative to*
- Tremendous promise to address food security

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Post-Harvest Loss Reduction

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for the Reduction of Post-Harvest Loss

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FtF Innovation Lab: Post-Harvest Loss

Technical focus areas:

-drying
-storage
-insect pests, mycotoxins

Cross-cutting:

-capacity building (universities, government; lab, curriculum, extension,…)
-nutrition
-gender

FtF Innovation Lab: Post-Harvest Loss

Integrating approaches

Success 1: novel/adapted drying technologies

Success 2: adapted storage technologies

Success 3: low cost moisture meter

Additional considerations:

e.g., Pathway to impact (actors,…),
Women's Empowerment in Agriculture Index

Integrating approaches: Bangladesh

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STR Dryer

USDA-ARS
PHLIL Moisture Meter

Improved (vs. traditional) storage

Integrating approaches: Ghana

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USDA-ARS
PHLIL Moisture Meter

Solar biomass
hybrid dryer

Adapted storage technologies

The road ahead

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Towards integration of mycotoxin reduction strategies

Critical gaps – addressing mycotoxins

- Good quality baseline information
- In country technical capacity
- Standardized sampling and testing procedures
- Surveillance tools: mobile diagnostics, modelling and mapping
- Alternative uses, decontamination
- Understanding the full scope of health risks

Towards an integrated approach

- Empowering and working in coordination with national partners
- Assessing a baseline *along with* potential interventions
- Appropriate interventions (context, cost, gender considerations,…)

Towards an integrated approach

- Involve private sector and regulators → co-regulation?
- Importance of risk communication
- Given geographic, biological, environmental and socioeconomic complexity, have a range of interventions available

Acknowledgements

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Ahmed Kablan

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