Integrating approaches to reduce mycotoxin contamination of crops

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Mycotoxins

- 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
Kenya alert over 2.3m bags of bad maize
2010 outbreak: Eastern Kenya posho mill maize survey

39% >LL aflatoxin (up to 60% by district)
37% >LL fumonisin

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

- Fungal population
- Crop management in field
- *Environmental conditions*
- Postharvest practices
A broad and expanding threat
A broad and expanding threat

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

Source: Battilani et al. (2016)

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
  - **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
Feed the Future Innovation Lab
for the Reduction of Post-Harvest Loss
Technical focus areas:
- drying
- storage
- insect pests, mycotoxins

Cross-cutting:
- capacity building (universities, government; lab, curriculum, extension,...)
- nutrition
- gender
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

STR Dryer

USDA-ARS

PHLIL Moisture Meter

Improved (vs. traditional) storage
Integrating approaches: Ghana

Solar biomass hybrid dryer

Adapted storage technologies

USDA-ARS
PHLIL Moisture Meter
The road ahead
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
Feed the Future – USAID

PHLIL team members (full set of partners at www.k-state.edu/phl/)

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