BecA-CSIRO aflatoxin project:
Capacity and Action for Aflatoxin Reduction in Eastern Africa (CAAREA)
CAAREA Phase II Objectives

**Focus:** aflatoxin in preharvest maize in Kenya and Tanzania. **Considered** ongoing projects for synergy and impact.

1. Establish aflatoxin diagnostics platform at BecA-ILRI
2. Characterize maize fungi from around Kenya and Tanzania
3. Screen maize germplasm for resistance
4. Test modelling as a potential predictive tool and use to contextualize findings regionally (risk map)
5. National breeders will affect subsequent changes to maize breeding programs in Kenya and Tanzania
6. Capacity building
Phase II output highlights
Aflatoxin/nutritional analysis capacity lacking in East Africa

Comprehensive labs lacking for research and capacity building.

Regulator lab capacity limited and long delays to results.

Private sector labs emerging, but limited capacity and expensive.

Lack of reference labs for the community.

2009-mid 2011
BecA aflatoxin team/lab bench

Aug-Nov 2011
Univ of Nairobi (Okoth lab)
BecA-ILRI Hub mycotoxin platform
Mycotoxin-nutritional analysis platform
Diagnostics development

Gold standard diagnostics established and validated (at BecA and in Australia).

New diagnostics suited to African context under development:

- Electronic nose: AusAID PhD student from 2014
- NIR: calibration development (within samples)

Sampling protocols under development.

KEY INSIGHT: Single kernel screening potential, key intervention for impact at mills. Blending for diagnostics is wrong!
Modeling: risk mapping and prediction

Component 1: risk mapping, GxE(xM) analysis
Survey team/tools finalized.
Ongoing on farm survey to generate risk maps and other tools.

Component 2: APSIM modeling
First APSIM model developed for aflatoxin in maize – accurate in field trial prediction.
Inoculated Field Trials

Led by KARI and ARI.

Team, design and regulatory approvals.

Fungal survey, inoculum production, NARI capacity and teamwork.

First inoculated aflatoxin field trials in the region (KARI and ARI).

Significance between genotypes (analysis ongoing) → BREEDING.
Capacity building
Capacity building

**Institutional capacity:**
BecA-ILRI Hub platform
NARI capacity and international linkages

**Human capacity:**
Team/network
BecA team expertise
Graduate students: 4 MSc, 4 PhD (3 AusAID scholarships)
ARI and KARI teams
6 ABCFs hosted

**Regional capacity:**
Platform used by 10 institutions (aside from CAAREA)
  with >12 more coming/in discussion. Includes Nutrition PhD program.
Established accepted lab design (milling) for aflatoxin work in Kenya.
Linked with PACA for use on priority issues – ABCF nominations.
Next phase

An integrated, multi-technology strategy for reducing aflatoxin risk and addressing contaminated maize is at the heart of phase III:

Effectively addressing aflatoxin will require the context-specific, tuned set of interventions to:

1) reduce the risk of aflatoxin accumulation in the first place, on farm (pre- and post-harvest).

2) conduct surveillance and use other means (eg, APSIM) to predict emerging high risk geographical areas as the growing season progresses.

3) target interventions to test and remove/decontaminate aflatoxin-containing maize (above the legal limit) from maize on farms and at mills.
Move current activities and outputs to impact

Activities:

1) Establish a vehicle to address aflatoxin contamination across the food chain
2) Enhance and expand use of the BecA-ILRI Hub platform
3) Support the development of node labs (NARI, Uni, private sector; Kenya, Tanzania, Ethiopia)
4) Validate and deploy mobile diagnostics
5) Validate and pilot interventions for contaminated grain (sorting, decontamination)
6) Finalize risk mapping and advance APSIM model (pathosystem research)
7) Validate integrated sets of aflatoxin intervention measures on farm, at storage and in mills
8) Capacity building
Move current activities and outputs to impact

Next phase intervention levels:

1) Reduce risk as much as possible on farm (varieties, management)

2) Surveillance to identify emerging hotspots (APSIM, mobile/networked diagnostics)

3) Targeting interventions as issues emerge (testing, decontamination, alternative uses)

4) R4D alliance – enabling environment, vehicle addressing the problem. COLLABORATIONS FOR INTERVENTION PILOTING
Customers including urban poor

Food Aid recipients

CMA - Commercial Cereal Mills

WFP P4P

Brokers

Village storage facilities (incl. WFP entrepreneurs)

Posho mills

Commercial farmers

Smallholder farms (aflatoxin risk areas; with surplus for sale)

Smallholder farms (subsistence farmers, rare surpluses; aflatoxin risk areas)

Key

Test and adapt risk reduction innovations

Business models

Reliant on scale-up funds

Can be enhanced with scale-up funds

FIPS: Education and options
Integrated system for aflatoxin reduction

Varieties matched to environments
Management practices
Integration of best practices and interventions

In season surveillance:
- APSIM model, track emerging risk areas
- mobile diagnostics

Contaminated grain:
- mobile diagnostics
- kernel sorting
- decontamination (traditional or advanced-mobile)

Integration of others’ technologies – collaboration (e.g., drying, storage systems,...)
Next phase

• Vehicle/Innovation platform
• Policy – PACA
• Biophysical sciences:
  – Mycotoxin/nut analysis platform – novel diagnostics (hosting)
  – Mycotoxin analysis along the value chains
  – Sampling/analytics platform
  – Pathosystem-fungal diversity (ABCFs,...)
  – Breeding
  – Decontamination
  – sorting
  – Mobile testing and decontamination
• Piloting interventions
  – Subsistence farmers (FIPS)
  – Commercial mills (CMA)
  – (potential) WFP
Estimated impact

Uptake of improved varieties, Kenya & Tanzania: 10.6 million
Kenya Cereal Millers Association – sampling/diagnostics: 10 million

Additional pathways to impact:
World Food Program
FIPS Pilot with ~100,000 people, scalable to their 1 million farmers (Kenya and Tanzania)
Increased Food Safety in East Africa

Capacity Building (including awareness)

Risk Mapping/Modeling

Resistance screening/breeding

Pathosystem understanding

Analytics platform

Inoculated Field Trials

On farm surveys

Diagnostics Piloting/Use

Participatory farmers

Pathosystem Research

National and private sector mycotoxin platforms

Regional capacity

BecA mycotoxin platform

Diagnostics development (CSIRO, UQ led)

Sample analysis

Capacity building

M&E; Impact Assessment
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QDAFF/BecA-ILRI Hub: Warwick Turner
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ARI: Arnold Mushongi (national maize breeder) and team
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Thank you
Phase III – Policy Engagement

Diagnostics and sampling protocols
With testing capacity, what are actions/options for contaminated maize?

Breeding
With screening capability/information, what are regulations for susceptibility/resistance in commercial varieties?

Risk mapping
Interactive decision making tools to model cost and impact of interventions.
Estimated impact

Uptake of improved varieties, Kenya & Tanzania: 10.6 million
Kenya Cereal Millers Association – diagnostics: ≤10 million
Extension work with subsistence farmers 175,000 ppl
Estimated direct impact (phase III): ~20 million people
Aflatoxin value-chain

Breeding → Production → Post-harvest / storage → Processing → Food / feed

Phase II

Phase III

Diagnostic/Data management/Quality Assurance

Capacity building

Information and advising (One Acre Fund, FIPS, …)

Additional crops/additional country

Large & small mills

Additional crops/additional country
Food chain analysis for strategic targeting of interventions

Varieties – risk mapping - diagnostics

Commercial mills
30% maize

Small posho mills
70% maize

WFP, extension

Food Chain Analysis

Learning – transfer
Capacity building

M&E

Alternative uses/decontamination/policy