



RESEARCH
PROGRAM ON
Agriculture for
Nutrition
and Health

LED BY IFPRI 

Joint CGIAR meeting on aflatoxins

21 February 2014

International Livestock Research Institute

Nairobi, Kenya

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Meeting summary

On 21 February 2014, participants from five CGIAR centres met at the Nairobi campus of the International Livestock Research Institute (ILRI) to share about their current aflatoxin research activities and plan for future activities in the next phase of the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) aflatoxin research portfolio.

The meeting was attended by representatives from the International Maize and Wheat Improvement Center (CIMMYT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Institute of Tropical Agriculture (IITA), ILRI and the Biosciences eastern and central Africa (BecA) hub.

In the morning, scientists presented their current aflatoxin research activities, the research gaps and opportunities they saw, and areas for development. In the afternoon, a session on theory of change was given by Hannah Guedenet, a communications consultant for HarvestPlus, following which, the scientists engaged in a working session implementing the theory of change model to aflatoxin safe foods. All presentations are available at:

<http://aghealth.wordpress.com/presentations-at-a-joint-cgiar-meeting-on-aflatoxins-21-february-2014/>

Ongoing aflatoxin research activities

Centres reported on their current research activities and interests.

BecA

Presentation by Jagger Harvey

BecA is a shared agricultural research and biosciences platform located at and managed by ILRI in Nairobi, Kenya. They have one major project on aflatoxins and some smaller collaborative activities.

Under Phase II of the Capacity and Action for Aflatoxin Reduction in Eastern Africa (CAAREA) project, the following activities have been completed:

- Establishment of an aflatoxin diagnostics platform at BecA-ILRI hub
- Characterization of maize fungi from around Kenya and Tanzania
- Screening of maize germplasm for resistance
- Testing of modelling as a potential predictive tool and use to contextualize findings regionally (risk map)
- National breeders effecting subsequent changes to maize breeding programs in Kenya and Tanzania
- Capacity building at regional level (both institutional and individual capacity building)

Countries: Kenya, Tanzania

Under Phase III of the CAAREA project, activities will include:

- Reducing risk as much as possible on farm through varieties and management
- Surveillance to identify emerging hotspots utilizing APSIM modelling, mobile technologies and networked diagnostics
- Targeted interventions to address issues as they emerge (testing, decontamination and alternative uses)
- Research for development alliance – an enabling environment and vehicle to address problems and collaborate for intervention pilots
- Policy engagement – diagnostics and sampling protocols, breeding and risk mapping

Countries: Kenya, Tanzania

Expected outcomes

- Science outputs assist national maize breeders and seed traders to improve maize varieties in circulation
- Farmers grow less susceptible maize varieties in appropriate environments
- Information helps government ministries and industry develop improved maize safety guidelines
- Diagnostics can be applied to different toxins in different crop and livestock commodities
- Diagnostic/mycology platform established for aflatoxin and fungal analysis
- Kenya and Tanzania risk maps produced using spatial models overlaid with management information and climate data

Challenges

- Diagnostics that are quick and affordable but also meet regulatory standards.
- Breeding for resistance is highly polygenic – variable based on environmental conditions. Looking for strains that are highly resilient in a variety of conditions throughout the East Africa region. Having to rescreen strains for resistance to maize lethal necrosis as the virus is devastating maize crops throughout East Africa.
- How to scale up some of the interventions to the farmers outside the non-governmental (NGO) extension reach (only about 10% of farmers are in the NGO extension reach)
- Market models for the informal seed sector where many farmers access their seeds, but where improved seed typically doesn't penetrate.
- Behaviour change in farmers

CIMMYT

Presentation by George Mahuku

CIMMYT leads the CGIAR Research Program on Maize and is interested especially in maize where aflatoxin is an important problem.

Current activities

- Breeding and mapping of aflatoxin genetic resistance in maize
- Documenting the incidence and prevalence of mycotoxin contamination in maize
- Validating the response of advanced inbred lines and soon to be released maize hybrids
- Biological degradation of aflatoxins
- Insect resistant maize for Africa – combining insect and aflatoxin resistance using doubled haploid technology
- Drought tolerant maize for Africa – multi-location trials and the assaying of mycotoxins in advanced inbred lines and hybrids
- Effective grain storage program – validating metal silos and hermetic storage structures (super bags) for insect management and aflatoxin control during grain storage

Countries: Angola, Burundi, Ethiopia, Kenya, Malawi, Mexico, Mozambique, Tanzania, Uganda, Zambia and Zimbabwe

Challenges

- Development of tools for rapid screening
 - Black light assay to identify fungal biomass
 - Quantitative polymerase chain reaction to quantify fungal biomass
- Combining drought tolerance, ear rot and mycotoxin resistance in breeding programs
- Developing methods of inoculation resistance for *A. flavus*

ICRISAT

Presentation by Samuel Njoroge

ICRISAT's aflatoxin program focuses on groundnuts, an important crop in Africa and Asia and one that is especially prone to aflatoxin contamination.

Current projects

- Crop rotation in Malawi and Zambia – maize, cotton, sunflower, groundnuts, millet sorghum and pigeon pea
- Amendment – gypsum, bio-char (activated charcoal) – different rates of amendments
- Modelling to predict aflatoxin contamination (21 to 49 days before harvest, Zambia and Malawi) – Auburn University
- Sorting and alternative uses
- Characterization of fungi (atoxigenic and toxigenic strains)
- Dissemination and communication (Shamba Shape-Up show highlighting different options for preharvest aflatoxin intervention – Kenya, Rwanda and Uganda)

Countries: Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia

IFPRI

IFPRI didn't have a representative at the meeting, so Delia Grace presented an update on their current aflatoxin research projects. IFPRI has research interests around economic and evidence aspects of aflatoxins. They have one major project and some smaller collaborative activities.

Current projects

1. Impact of aflatoxins on stunting in children
2. Impact of management strategies on aflatoxin control
3. Consumer demand for aflatoxin-tested and certified maize flour

Country: Kenya

IITA

Presentation by Francesca Nelson

IITA has a multi-faceted, multi-million dollar research portfolio, with bio-control featuring as a key technology upon which other technologies can be integrated.

Ongoing project: Developing a strategic framework for the East African Community on key aflatoxin policies. The six key policy packages being developed are:

1. Health
2. Agriculture
3. Good agricultural practices
4. Economic impacts
5. Alternative uses and disposal
6. Communications

Countries: Burundi, Kenya, Rwanda, Tanzania and Uganda

ILRI

Presentation by Johanna Lindahl

ILRI has research interests at the animal and human health interface of aflatoxins. It has one major project and smaller collaborative activities.

MyDairy project

Focus: Measuring and mitigating the risk of mycotoxins in maize and dairy products for poor consumers

Objectives

- Health and risk assessment of aflatoxins in the dairy chain
- Biological control of aflatoxins in foods through lactic acid bacteria and whey proteins

- Mapping aflatoxin risk factors in Kenya
- Weather-based early warning systems for mycotoxins in Kenya based on a system currently used in Finland

Activities planned for 2014

- Quantitative risk and economic assessment
- Exposure assessment via milk for consumers in Nairobi (with Afla-extra)
- Final analysis, publication and dissemination of the qualitative studies in nine districts
- Validation of a competitive enzyme-linked immunosorbent assay for serum
- Assessment of the association of aflatoxin in pigs and growth

Outputs

- ILRI asked to write technical packages for submission to the East African Community
- Five presentations at conferences
- Press conference and media round-table
- Feedback and training to all farmers in study

Countries: Ethiopia, Kenya, Tanzania, Uganda and Vietnam

Afla-extra

Focus: Support cross-centre activities and scoping of new areas of work

Activities

1. Supporting activities to build an evidence base for investment in aflatoxins for Phase 2
 - Aflatoxin risk report and risk mapping to capture information on aflatoxin prevalence, risk factors and control
 - Markets for aflatoxin assured products: Willingness to pay for aflatoxin-free milk in Nairobi and aflatoxins in raw and pasteurized marketed milks
 - Burden of aflatoxins and feed markets for aflatoxin assured products: Impact of aflatoxins on pig and poultry growth
 - Contributions to 2020 briefs on aflatoxins
2. Supporting meetings for developing joined up plans
 - Session at the Science Council in September 2013 drew attention to examples of aflatoxin control as examples of agriculture-based interventions for human health
 - Second joint CGIAR meeting on aflatoxins brought together scientists from five CGIAR centres to share about current research activities related to mycotoxin

research and plan for the following phase of mycotoxin research portfolio in Naivasha (November 2013)

- Regional CGIAR aflatoxin meeting in Nairobi (February 2014)
- Third joint CGIAR meeting on aflatoxins in Washington DC in March 2014
- Consultant to support working groups in developing theory of changed and joined up plans for Phase 2

Outputs

- Aflatoxin risk report
- Papers on willingness to pay for aflatoxin-free milk and aflatoxins in animal feeds
- Aflatoxin working groups formed across all CGIAR centres
- Paper requested for *Philosophical Transactions of the Royal Society*

Theory of change seminar

Presentation by Hannah Guedenet, HarvestPlus communications consultant

With the significant focus in CGIAR on making a difference in the development agenda, there is a need for CGIAR research programs to understand and be able to explain how their research efforts are expected to contribute to development impacts. Additionally, as CGIAR research programs focus on making an impact with their research, they need to be able to monitor their progress along the pathways they are using. Finally, because CGIAR research programs are setting ambitious intermediate development outcome targets over the next 10-15 years, they will need to show they have indeed contributed to these development outcomes.

Theory of change explains how the activities of the intervention are expected to lead to the desired impacts. The process identifies building blocks that are required to bring about a given long-term goal. In addition to a diagram that shows the pathway from activities to outputs to a sequence of outcomes to impacts, a narrative also explains why the various links in the pathway are expected to work.

Hannah shared three draft theories of change for three crops and countries in the HarvestPlus biofortification research portfolio: maize in Zambia, beans in Rwanda and cassava in Nigeria. The examples showed how identifying the goal of each research project generated research questions, how to measure adoption, how to drive behaviour change, how to reach target populations and future research needs.

Theory of change working session

The meeting participants practised the theory of change mapping good agricultural practices are available to farmers → farmers adopt good agricultural practices → crops have less aflatoxins → population eats safer crops → populations have reduced exposure to aflatoxins.

In the process of creating the impact pathways, many different assumptions were identified:

- Some technologies are not widely accessible
- Farmers lack knowledge
- Cost and labour must be very low
- There are currently few incentives to produce aflatoxin-free products
- Aflatoxin-safe products have other desirable properties that can help facilitate uptake of improved seeds, adoption of good agricultural practices and consumer willingness to pay
- Retailers do not like to market on safety
- The poor are the most vulnerable to consuming highly contaminated foods

External factors identified that would either increase or reduce aflatoxin exposure along the impact pathways were:

- Changes in dietary diversity (for example, switch from groundnuts to another more expensive protein)
- Changing to more processed foods

Acknowledged research needs

1. Evidence for health impacts apart from poisoning and cancer
2. Evidence on other factors which influence toxicity, for example, hepatitis/malnutrition/disease
3. Identify few key good agricultural practices based on contribution to aflatoxin reduction
4. Integrate aflatoxin resilience into national breeding programs. Resistant strains must be able to compete on yield since this is currently the only standard in the national performance trials.
5. Seed companies must be convinced/incentivised to sell aflatoxin resilient seeds
6. Behaviour change: Farmers may be unwilling to try new varieties, particularly in areas where farmers typically only grow one variety.

Possible synergies

Over the course of the meeting, several synergies across the CGIAR centres were identified.

These were:

1. Weather-based modelling systems for aflatoxin risk (BecA, CIMMYT, ICRISAT and ILRI)
2. CIMMYT to liaise with BecA to access their five-year data on their hybrid lines and aflatoxin accumulation for use in the BecA modelling
3. CIMMYT has the number of farmers and areas under cultivation using aflatoxin-resistant lines for use in mapping and modelling

Research gaps

Some of the research gaps discussed during the course of the meeting included the following:

- Inventory of diagnostics: efficacy and cost
- Combining drought tolerance, ear rot and mycotoxin resistance in breeding programs
- Quantifying what resilience means in terms of reduced aflatoxin risk
- Use of mobile technology, radio and other platforms to disseminate risk mitigating information to rural farmers
- Effect of aflatoxin standards on regional consumption patterns
- Quantifying aflatoxin consumption in milk contributes to cancer cases per year
- Serum aflatoxin test validation in other livestock species ; ICRISAT is working on validating pig serum
- Risk mitigation for highly contaminated feeds in livestock, for example, use of binders
- Risk promoting practices in milk: addition of flour, water and sugar to extend milk
- Risk analysis in supermarket milk in Kenya

Annex 1: List of participants

Name	Institution
Jagger Harvey	Beca-ILRI Hub
George Mahuku	CIMMYT
Samuel Njoroge	ICRISAT
Francesca Nelson	IITA
Delia Grace	ILRI
Johanna Lindahl	ILRI
Christine Atherstone	ILRI
Sara Ahlberg	ILRI
Irene Kagera	ILRI

Annex 2: Agenda

Objectives

1. The morning sessions (0900-1300 hours) are formatted as an institute seminar highlighting ongoing aflatoxin research projects across the CG centres
2. The afternoon session (1400-1600 hours) is for the aflatoxin working groups to begin developing plans for Phase 2 funding proposals under A4NH

9am-10:30am

Introductions of teams

Delia Grace

Short presentations

Johanna Lindahl

- Past work and results

Jagger Harvey

- Ongoing projects

George Mahuku

- Expected outputs

Samuel Njoroge

- Impact

Anitha Seetha

Francesca Nelson

10:30 – 11:00 am Tea/Coffee break

11:00 am -1:00 pm Discussion

- Planned projects for the future
- Synergies

1:00 pm – 2:00pm Lunch break

2:00 pm – 4:00 pm Theory of change
Plans for Phase 2

Hannah Guedenet
Aflatoxin working groups