Zonal Aflatoxin Workshop Report

Aflatoxin Challenge in Northern Uganda and the role of communication on mitigating the aflatoxin induced decline in house hold productivity.

Theme: Improving Health, productivity and Food Security through Zonal Efforts to Mitigate Aflatoxin Contamination

26th May 2016

Pacific Grand Hotel, Lira, Northern Uganda

Summary

National Crops Resources Research Institute (NaCRRI) in partnership with International Institute of Tropical Agriculture (IITA) and Ngetta Zonal Agricultural Research and Development Institute (NGEZARDI). Held a Zonal workshop on the aflatoxin challenge on 26th March 2016. The theme of the workshop was "Improving Health and Food Security through awareness on Aflatoxin Contamination and associated dangers". The three objectives of the workshop were to sensitize stakeholders in the production value chain, high-level decision-makers and industry leaders on the magnitude of the aflatoxin challenge in the zone; engage multi-stake holder platforms, experts and relevant stakeholders on setting zonal priorities and initiating work on the zonal action plan. In keeping with workshop objectives, the presentations from NaCRRI, Ngetta-ZARDI, and High profile decision makers sensitized stakeholders on dangers of aflatoxin, the organizational initiatives and technologies and, research solutions that are being successfully applied to mitigate the aflatoxin challenge. The workshop identified priority areas necessary for combating the aflatoxin challenge and the proposed interventions for dealing with the challenges were also proposed. The challenges identified include low awareness among key actors / stakeholders, knowledge gaps and ignorance inadequate capacity in human resources, systems and infrastructure and weak regulatory frameworks. The workshop proposed interventions which included: Regulatory system to show where Aflatoxin is and how much, determine risk to justify intervention, awareness raising campaigns, institutions and individuals to champion costs and share data. Communication to the farmers - to get buy-in from the farmers and enhancing awareness creation through targeted education, knowledge sharing; mass media etc, to include food safety (aflatoxin).

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Background to the Workshop

The aflatoxin challenge constitutes a significant threat to food and economic security, and undermines poverty eradication in Northern Uganda. It is a major cause of post-harvest loss that further constrains the quality of food reaching the zonal markets and households across the country. In addition, aflatoxins pose a major public health challenge to consumers all over the country and can result in foregone revenues and profit from domestic and regional trade hence the poor balance of payments.

Aflatoxin is a poison naturally produced by strains of the fungus *Aspergillus flavus* and related species. Aflatoxin contamination poses a big problem in the entire zone. Aflatoxin contamination commonly occurs in maize, groundnut, and crops of zonal importance in Eastern and Northern Uganda such as sorghum and millet. According to Kaaya and Wareen (2005) research findings, contamination frequency in the tune of 10 – 60% of maize and groundnuts is encountered in many parts of the ecological zone. According to WHO (2011), aflatoxin contamination leads to 64% reduction in food quality in Uganda. Aflatoxin contamination can be associated with a number of health problems. In human health, aflatoxins cause liver cancer and are associated with stunting and kwashiorkor in children and immune suppression (Gong *et. al*., 2002, 2003, 2004; Turner *et. al*., 2003, 2007) the chronic aflatoxicosis induced productivity challenge are not uncommon in the northern Agro-ecological zone. In animal health, specifically livestock and poultry, aflatoxins have been associated with deaths and ill health including decreased milk and yield, reduced protein efficiency ratio and reduced vaccine efficacy.

Evidence shows that aflatoxin ingestion is frequent through contaminated foodstuffs and is one of the major etiological factors in human hepatocellular carcinoma (HCC) in northern Uganda. Children under 5 remain particularly vulnerable to aflatoxin exposure significantly hindering children's growth and development while damaging their immunity. In 2004, several hundred Kenyans became severely ill, and 125 died, of acute aflatoxicosis: a disease of liver failure associated with consuming extremely high levels of aflatoxin in food (Lewis *et al*. 2005; Strosnider *et al*. 2006).

Aflatoxin contamination in foods in the NAEZ are occasionally above the internationally recommended maximum limits. High levels of aflatoxin contamination including outbreaks of acute aflatoxin poisoning leading to hundreds of deaths were also reported from East Africa (Probst *et al*., 2007). Because of the serious food safety risks, human exposure to aflatoxins is

limited by regulations. The maximum concentrations of aflatoxin permitted in food for humans are less than 20 ppb in the U.S.A., and less than 4 ppb in the EU. Contamination therefore presents a barrier to cross-border trade and economic growth as the presence of excessive aflatoxin levels causes grain exports to be rejected by importing countries. If all countries were to adopt EU standards on aflatoxins, then global trade would decline by $3 billion (Dohlman, 2008).

The aflatoxin problem is so complex that it straddles the agriculture and food security, trade and health sectors. Cognisant of these, in March 2011, the 7th CAADP Partnership Platform noted the importance of advancing sanitary and phyto-sanitary (SPS) matters within CAADP to enhance food security and market access. In this context, the sensitization workshop underscored the need to address aflatoxin control and other SPS challenges in a holistic and integrated manner across the entire value chains.

PACA aims to provide consistent coordination and coherent leadership to the continental efforts on aflatoxin control. It aims at supporting adoption of proven solutions, and identifies new ones, that will work to mitigate the impacts of aflatoxin on food security and agriculture, trade, and health in Africa. Many actors are involved in developing comprehensive solutions to control aflatoxin along the value chain, from crop production through processing and food preparation to consumption. Many measures can be taken to reduce aflatoxin exposure to local consumers and improve opportunities to sell aflatoxin-safe crops to markets, but some options need to be supported by appropriate policy and regulatory actions. It is expected that comprehensive and feasible solutions being developed for the African context will also be useful for other regions where aflatoxin is a problem. Combating aflatoxin will also contribute to the Millennium Development Goals (MDGs) and PACA will look for ways to contribute to the MDGs and the post 2015 development agenda. The workshop was held in Lira 26 May 2016 at Pacific Grand Hotel with the following objectives:

- Sensitize stakeholders, high-level decision-makers and industry leaders on the magnitude of the Aflatoxin Challenge in the NAEZ.
- Multi-stakeholder platforms, experts and relevant stakeholders on setting zonal priorities and initiating work on the zonal action plan.
- Facilitate lesson sharing on industry mitigation practices and public regulatory frameworks.

- The zonal aflatoxin workshop was attended by a total of sixty one (61) participants, including aflatoxin experts drawn from 3 NARO National institutes and Ngetta ZARDI. The names, Agencies of origin and the institutions they represented at the workshop are detailed in Annex 2.

Workshop Process

The overall approach to the workshop was participatory and consultative in nature. Ngetta-ZARDI engaged officers from various national and international agencies in setting the climate for the workshop. The workshop process ensured the agency representatives were fully involved through presentations, group discussions and 'question and answer' sessions. The workshop started with an opening session which was followed by topical technical briefs, presentations from agency representatives, zonal experiences, private sector and industrial experiences. Finally the agency representatives were engaged in the question and answer sessions and an official closing ceremony by a representative of the Lira District Residential District Commissioner.

Workshop Proceedings

Opening Session

The workshop opened with introductory remarks by representatives of development partners comprising the Institute for Tropical Agriculture (IITA) representative, before this, livestock nutrition Expert, Mr. Nviiri Geofrey, presented the workshop objectives and clarified the focus of the workshop to the production and value chain key actors. Following the introductory remarks, the Director Ngetta ZARDI gave an introductory speech and brief on Ngetta-ZARDI and its mandate and finally Mr. Ssrumaga Julius shared a brief on the Aflatoxin Policy and planning for East Africa (APPEA). The opening ceremony was chaired by Mr. Kumakech Alfred who invited the Chief Guest, to officially open the workshop. In his opening remarks, he welcomed agency representatives to Northern Uganda. The chief Guest applauded NARO for convening the zonal workshop on the aflatoxin challenge and awareness creation in the Northern Agro-ecological Zone. Noting that aflatoxin contamination is a multi-faceted trans-boundary problem, the Chief Guest emphasized that interventions take a holistic approach, involving public and private stakeholder participation, a sector-wide approach, Zonal and national collaboration and, indeed new approaches, such as, the use of bio-control technologies that have been successful in other countries like the United States of America and Nigeria among others.

Session I: Technical presentations

By Mr. Sserumaga Julius on the behalf of NaSARRI

Highlighted the Occurrence of *aspergillus* section *flavi* and aflatoxin contamination of peanuts in Uganda

The presentation was based on the following Objectives:

- To determine aflatoxin levels in peanuts sampled at harvest from different agro-ecological zones in Uganda.
- To determine the prevalence of *Aspergillus* section *Flavi* from peanuts sampled in different agro-ecological zones in Uganda.

He also briefed the audience on the sampling protocol for scientific critiquing and appreciation

- Peanut sampled from field during the harvesting season (January 2015) and delivered to Kenya in July (2015) for mycotoxin analysis.
- Samples collected from 21 districts in Uganda (total of 183 samples).
- Samples were dried in the sun (Uganda) and at 45°C for 48 hours in the oven (Kenya) to reduce moisture content (<13%)
- Samples ground using blender and packaged for mycotoxin analysis

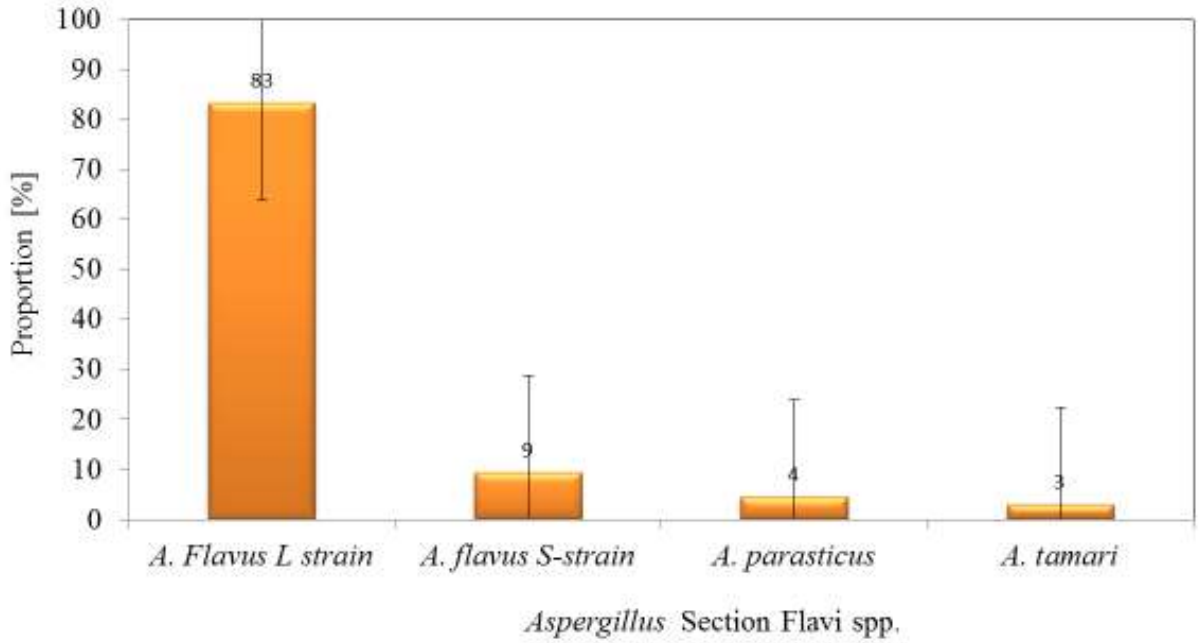
Quantification and Idenification

- *Aspergillus* section *Flavi* were isolated on modified Rose bengal agar and identified on 5/2 media based on cultural and morphological characteristics.
- Aflatoxin quantified by Accuscan Pro method

***A*.Section *Flavi* strains**

- *Aspergillus* flavus L-strain was significantly the predominant strain of *Aspergillus* section *Flavi* isolated from the peanuts in all the districts of Uganda (average 88%; p-value <0.05).

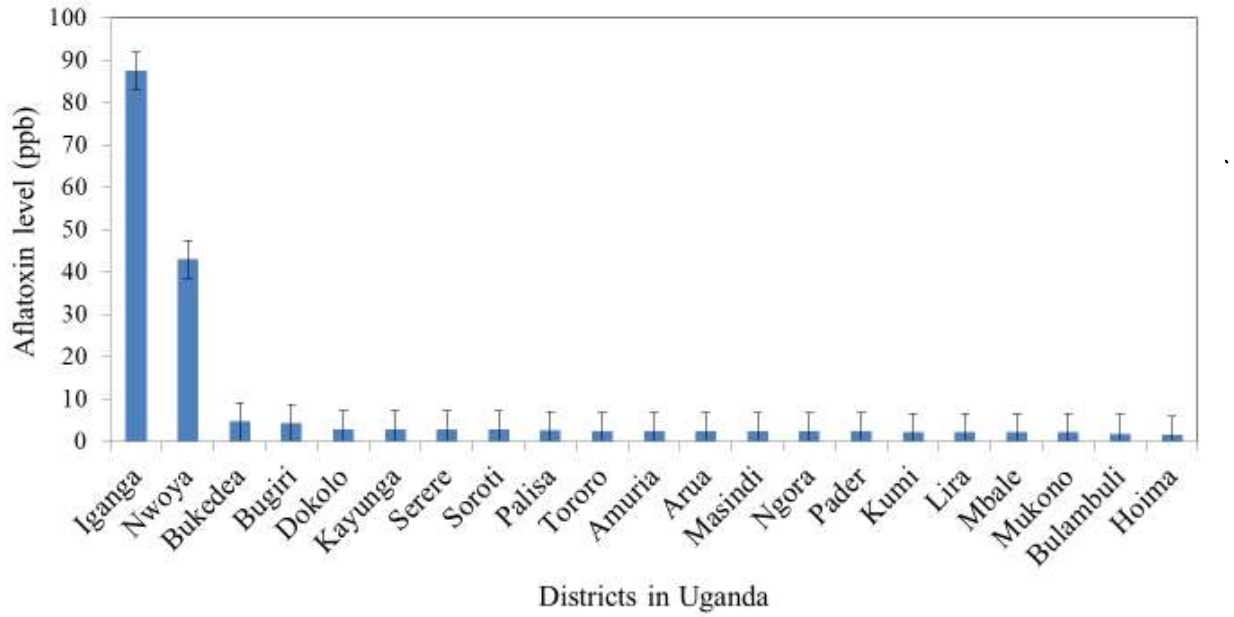
- Other strains were isolated in low percentage

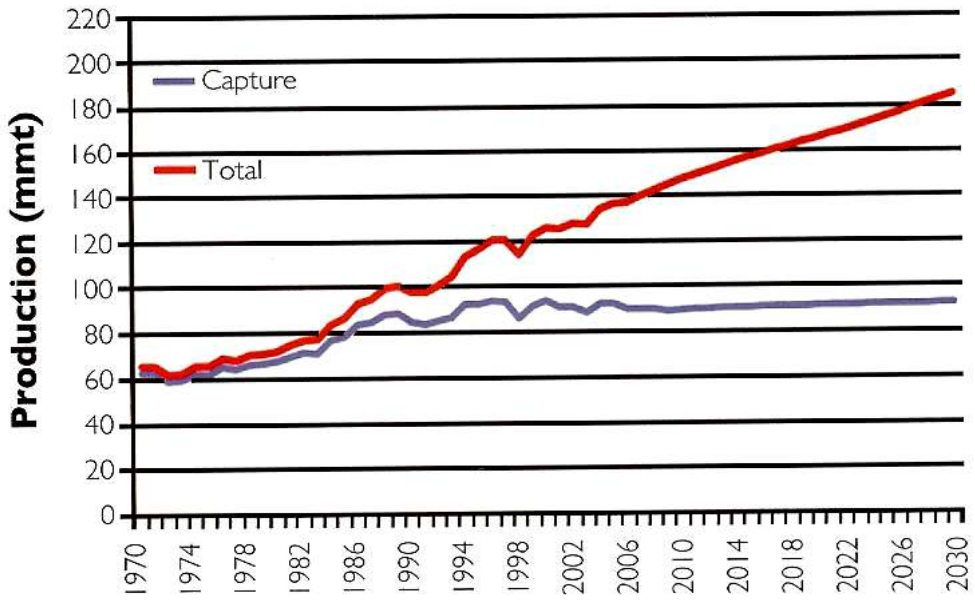


acute and chronic diseases and even death. Of concern also is the effect of aflatoxin on trade. Groundnut export to Europe is rejected due to non-compliance on aflatoxin levels. There is therefore need for both medical and

Aflatoxin contamination

- ❖ Aflatoxin highest in Iganga (87.5ppb) & Nwoya (43ppb) districts.
- ❖ Aflatoxin levels ranged between <LOD and 1326.5ppb.





Aflatoxins & Fish

Flatoxin:

- A naturally occurring mycotoxin produced by *Aspergillus* molds.
- Invisible, odorless and tasteless toxins.
- Very heat stable therefore not affected by pelleting and extrusion processes of fish feeds.

- Poisonous and cancer-causing.
- In fish, the source is feed resources from plants.
- Fish meal (Mukene) is now replaced by less expensive plant protein in feeds posing a higher risk of contamination.
- Limited information on the risk levels of different mycotoxins for different aquatic species.
- Effects/susceptability depends on the;
- **Species** Marine & cold > warm- water fish,
- **Age** Fry > adult fish
- and **Concentration** in the feed.

Clinical signs in Fish

- Aflatoxicosis **targets mainly the liver**.

- Other pathological changes are due to alterations in liver function enzymes (Sur and Celik, 2005).
- Protrusive eyes
- Severe hemorrhage on dorsal, anal and caudal fins.
- Caudal fin erosion and loss.
- Discarded scales
- Thick mucus on skin
- Low-motion
- Lethargy
- Less feed acceptability.
- Uncharacterized and damaged liver.
- Heavy mucus in the viscera & the abdominal cavity.
- Enlarged gall bladder (filled with bile)
- **Source:**
- http://www.thefishsite.com/articles/1702/medicinal-herbs-against-aflatoxicosis-in-nile-tilapia-clinical-postmortem-signs-and-liver-histological-patterns/#sthash.5Bnef4R9.dpuf

Remedy

- **Ginseng and Nigella sativa oil**

Dose:

Injected at 1% of body weight

Action:

Reduce the development of hepatotoxicity in the liver by AFB_1 (Zaki et al., 2011)

- **Nigella sativa oil**
- **Calyx of Hibiscus sabdariffa**
- **Ceylon cinnamon**

Action:

biologically safe control additives against aflatoxin

(El-Nagerabi et al. (2012)

Economic Implication

- Profits are lost due to decreased efficiency in production (eg. **slow growth**, **reduced weight**, **increase in FCR** and **increased medical costs**.

In Thailand, there was a shrimp crisis (over 50% decline) due to the early mortality syndrome caused by **aflatoxins**. (**News date:** 2013-12-15). Till today the industry has not recovered fully

Utilization of Ugandan Bentonites to mitigate the aflatoxicosis induce decline in poultry productivity

by Nviiri Geofrey & Mugerwa Swidiq

What can be done? Limited options

- Only buy uncontaminated grains
  - But difficult to accomplish because even if you analyze for toxins you may miss them.
  - Usually contamination is not uniformly distributed throughout the sample.
  - Sometimes nothing but contaminated grains are available.
  - Remember – not possible to remove toxins by heating or washing.
- Use mycotoxin binding sorbents to sequester toxins
  - This approach – first reported in 1988 by Phillips & Taylor, et al. – has over 30 years of peer reviewed research and commercial use proving its viability and utility.
  - At last count, there were over 100+ companies world-wide offering mycotoxin binders – and new offerings are made practically every day.

Early History of HSCAS as Aflatoxin Binder

1. 1988 – Phillips, Taylor, Kubena, Harvey show 0.5 wt% hydrated sodium calcium aluminosilicate (HSCAS) protects CHICKENS against 7.5 ppm AFB_1 (Poultry Sci., 67, 243-247)
2. 1989 – Harvey, Phillips, Kubena, et al. show HSCAS protects SWINE against AFB_1 (Amer. J. Vet. Res., 50, 416-420)
3. 1991 – Kubena, Huff, Harvey, et al. show HSCAS protects TURKEYS against AFB_1 (Poultry Sci., 70, 1823-1830)
4. 1991 – Harvey, Kubena, Phillips, et al. show HSCAS protects LAMBS against AFB1 (Amer. J. Vet. Res., 57, 152-156)

5. 1994 – Phillips, Harvey, Kubena, et al., show HSCAS protects GOATS against AFB_1 (J. Anim. Sci., 72, 677-682)

Evaluating Mycotoxin Binders

- Two possible approaches…
  - *In-vivo* testing
    - Uses live animals
    - Uses mycotoxin contaminated feeds
    - Uses mycotoxin binder mixed with contaminated & uncontaminated feeds.
  - *In-vitro* testing
    - Does not use live animals
    - Generally uses low level of mycotoxin dissolved in water.
    - Uses mycotoxin binder to remove the mycotoxin from the water.

  Usually does not use mycotoxin contaminated feeds.

- Obtain a representative group of commercially available binders.
- Measure aflatoxin B_1 binding under a constant set of conditions

… (20 µg toxin / 1 mg binder / 1 mL)

- Obtain XRD & measure complete set of physical & chemical properties.
- Determine if aflatoxin binding correlates to any particular property

… or combination of properties

***In-Vitro* Binding vs. Physical / Chemical Properties of Mycotoxin Binders**

- No single physical property correlates with *in-vitro* binding of aflatoxin
- No single chemical property correlates with *in-vitro* binding of aflatoxin
- … however, there is a weak correlation with combination of strong

Awareness raising and capacity building to combat aflatoxin

Presented by: Elong. C & Nviiri. G NgettaZARDI

Aflatoxin(s) impact the 4 pillars of food security :

- availability of food
- access to food
- utilization of food
- stability in each of these three elements.

Status quo

- Direct impact of aflatoxin contamination on agriculture and perceived food security is negligible
- Very low public and institutional awareness of aflatoxin
- Aflatoxin contamination often does not cause visible damage to the crop
- Farmers do not lose or have to discard harvest because of aflatoxin contamination, only very rarely they face lower prices for aflatoxin-contaminated grains

Communication challenges

- Aflatoxins are colourless and odourless
- Aflatoxins may form even before visible mould growth; BUT not all mould results in toxin
- Only through analysis (mostly lab BUT now also field base) are aflatoxins detected
- Translating survey results and risks in a way that is informative for a majority of stakeholders is a challenge. **everyone should be concerned**
- Control measures show rarely immediate or visible effect
- Management practices – do make grains cleaner
- Bio-control – It's hard to communicate about Bio-control in simple terms.
- Control measures are mostly labour (management) or capital intensive (inputs)
- A large number and categories of stakeholders and sectors need to co-operate and collaborate to effectively address aflatoxin (*effect in health; solutions in agriculture*)

What institution

Capacity of various organizations to communicate on aflatoxin and its control.

- farmer associations,
- private sector
- schools,
- the media,
- local and national decision makers, agricultural extension services,
- variety of researchers (*not necessarily specialists in aflatoxin*)
- need support to have credible sources of information

Important lessons

- Finding a **local concept for aflatoxin** ***(using already known concepts, often hard to describe in local language)***
- Researchers might not be the best communicators of this local information
- Use of a *combination of communication media and methods builds understanding*
- Innovation Platforms, Learning Alliances, multi-stakeholder processes – will be of central importance
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What media to use

- Face-face/stakeholder meetings
- Print media (*extension leaflets, factsheets, poster); journal articles; policy briefs*
- Training sessions/training of trainer
- Radio & TV
- Possible call-in and feedback via SMS
- Video or video-animation *(making the invisible visible)*
- Phone (short animations, SMS-messages)

Capacity building

- Raising awareness of policy makers and mobilizing political will
- Raising awareness of producers groups and marketers on impact of aflatoxins and potential benefits of technology solutions;
- Raising awareness of consumers groups, health & nutrition personnel on the impact of aflatoxin on health;
- Emphasis on the roles of Private Public Partnership (PPP) in promoting awareness, *training and dissemination and adoption of appropriate aflatoxin-control technologies;*
- Building/strengthening local institutions capacity for proper sampling and testing for aflatoxin

Strengthening the surveillance and monitoring system.

- Requires focus on causes not symptoms
- No single solution/golden bullet
- Integrated and coordinated actions needed
- Across disciplines and actors
- Requires multi-stakeholder actions

The question and answer session chaired by Mr. Kumal on behalf of the director Ngetta-ZARDI

1. We process a local brew called "Lira lira" from Cassava that is rather moldy, what are the chances that aflatocins are entering this drink?(Nixon,Kole)
2. From the presentations, it was said that even if you burn it to over 380 degrees, it's difficult to destroy any aflatoxins in there. You will find aflatoxins even in from Bushere or in breast milk, if the lira does not reach the temperature of disintegrating the aflatoxins in it
3. The presentations showed local varieties of maize have more levels of aflatoxins; what is causing this? Is it the genetic makeup that is making local varieties more susceptible to aflatoxxins or the time these varieties take in the field that make them predisposed to aflatoxins? Practices? Genetic make-up of either variety?(Emmauel, FAO)

a. Everything in this study was categorized as local because we didn't have a name to it but I would attribute these levels. Most aflatoxins are caused by drought and insects.
b. There are more aflatoxins after harvest but where does it start from? Is it at the pre harvest period but I can give a conclusive answer because local varieties have no new traits in them.
c. The more it stays in the field, the more it gets predisposed to aflatoxinc

4. Husk cover association with aflatoxins: can we breed varieties that cover the entire maize cob? Have you identified some varieties that completely cover the maize cob? There are many traits to describe what predisposes maize to aflatoxins
5. What varieties that were tested, where they having any levels of aflatoxins? And which varieties were tested for? (Dorcus, Lira)
6. Is calcium Bentonite and activated charcoal available in Uganda? Yes, it is locally available in Uganda. Shops that deal in agribusiness/livestock feed shops do sell aflatoxin inhibitors though these products do not add any valve to your product.

a. Calcium and sodium Bentonite though the calcium is more important.
7. Sunflower and soya? Do they have aflatoxins? Yes they do produce aflatoxins
8. What are some of the signs and symptoms of this in the body? It's like when one has been poisoned, it destroys key issues within the body. Liver damage, in Uganda, we have chronic cases of aflatoxins.
9. According to your statistics, how do you relate northern Uganda?
10. When you eat ground nuts and they taste bitter? What is that? Is it alfatoxins? Aflatoxins have no taste nor color
11. When drying g/nuts, can it be contaminated when in the pod or after it has been opened?
12. When I have a seed that is filled with aflatoxins, how long does it remain viable for human consumption before being discarded?
13. If I have a seed, does it remain safe from Aflatoxins(Clean seed in an area where the fungus exists)
14. Pathogens enter g/nuts at a very tender age that's why when you open a pod, it's already open. It's not because the seed has aflatoxins, but the fungus feeds on it to infest it with aflatoxins. When is meets a fungus when it has not fed to produce aflatoxins.

Packaging of seeds/produce: requesting researcher to abolish kaveera bags for sack to allow aeration. The bags should be standardized, in Kenya and Tanzania, there are no bags of more than 100kgs

With liberation of the economy, people buy and sell anything with reckless abandon. Even we research and document things but government is keeping quiet, we shall not get any work done.

The presence of security in this matter, thieves force farmers to harvest and dry it stealthily to save his produce. The problem is greater than that. In the past, you unlike he last up the g/nuts and bag it to sell it to the market before it dries. Unlike the past where it took 3 weeks to dry be

Poor roads also affect the quality of the seeds, the farmer will

The issue of policy is a serious matter, they should also look at the fact that how do farmers been courage r to overcome that loss so that in future they produce and process better harvest otherwise if there arfe no systems in place, then farmers will still sell produce before it really dries.

The issue of silos, what is happening? This will help farmers to store stock for sale.

Is this research in collaboration with seed/grain companies to help raise awareness about aflatocins since they have networks that reach the farmers and could lead to control of this?

If my feed is moldy, what should I do? There is no system in Uganda that warns to people that if they sell moldy grain, it's a crime.

Aflatoxins binders can be used to reduce it to levels that are not toxic to animals and safe for consumption. We need to raise awareness that contaminated grains to reduce the toxicity of the affected grain down the food chain.

A lot of work is going on in Makerere and the research institute to share and work together towards improving the situation in Uganda?

It has been recommended and will be spear headed by MAAIF.

The issue of awareness creation is very important yet in Europe it was started in 1962,

A lab in Lira that is doing research on aflatoxins but is redundant? Where is it?

Why should a farmer spend on finding out about the levels of aflatoxins in his produce yet it does not affect the price of his produce?

Need for another meeting multi stake holder meetings

Are humans allowed to consume these aflatoxins binders? Charcoal tablets but how often should one eats charcoal? The moment it enters the blood stream, we need to b

Small holder dairy farmers and humans:

Conclusions and Recommendations

Scaling up use of Biocontrol technology option.

The use of aflasafe is a notable contribution to aflatoxin control and its use is profitable using a package approach, farmers stand to gain more. Proof of efficacy of this bio-control product and others is a necessary process as part or registration of the products in target countries. There is need to hasten registration processes of this technology in member countries. Role of industry is

crucial in scaling up use of Biocontrol technology and in the implementation of aflatoxin control regimes.

Harmonized biopesticides registration framework (e.g. Biocontrol technology).

There is need to consider harmonizing the regulatory framework for registration of biopesticides to provide economies of scale and scale up production of Biocontrol products, which can reduce the price and increase availability to small holder farmers. The private sector should drive the process supported by a conducive regulatory framework. Other technologies other than aflasafe are available and there is a lot of evidence the technology works considering that they have gone through a process of thorough evaluation

Role of food control systems.

Aflatoxin control should be anchored on national food control systems. There is need to improve food control systems in all levels of production and ensure inter-zonal coordination of activities towards aflatoxin control. Most critical is up to date standards and regulations, surveillance and monitoring, laboratory services, education and awareness, including promotion of good practices Including food safety in curriculum on nutrition, agriculture and trade is one way of increasing awareness about the food safety problem. Continuous surveillance is necessary for any risk mapping because some hot spots today may not be such tomorrow.

Alternative uses of affected products

Regarding how to deal with contaminated material, there must be disposal regulations developed in the respective zone if the levels go beyond what can be sequestered by aflatoxin binding feed additives, including provisions for destruction of the contaminated material and enforcement of the regulations. However, Lack of enforcement remains a notable challenge.

Closing Remarks from the RDC

The organizers in partnership with APPEAR, want to thank you for organizing this meeting and all stakeholder are good ambassadors for these left behind.

It might be difficult for us to explain this term but better to move than to stay behind. The press have that natural skill, the way you publicize your things, try and make this story know. Spread the gospel and let them know

Awareness is kind of preventive and I wish to take his moment to thank the presenters and sponsors. The message will go better little than never; we shall act as mustard seeds and spread the gospel everywhere.

Annex 1

Program - APPEAR Project Aflatoxin Sensitization Workshop

Time	**Activity**	**Session in charge**
8.30 - 9.00am	Arrival and registration	Prossy Namulindwa
9.00 - 9.15am	Welcome and introduction of participants	Kumakech Alfred
9.30 – 9:45am	Remarks for Director Ngetta ZARDI	Dr Laban Turyagenda
9.45 – 10:00am	Official Opening of the workshop	CAO Gulu
10.00 - 10.15am	Brief presentation on APPEAR Project	Mr. Sserumaga Julius
10:15 -10:30am	Progress on the APPEAR project	Mr. Sserumaga Julius
10.30-10:45am	Progress of APPEAR project on ground nuts	Dr. Moses Biruma & David Okello
10.45-11:00am	**PHOTO SESSION /TEA/COFFEE BREAK**	Christine Elong
11:00-11:30am	Background Presentation 2: Progress of APPEAR project on maize	Mr. Sserumaga Julius
11:30 - 12:00pm	Phytosanitary measures to be undertaken to reduce the inoculum load of *Aspergillus spp*	Kumakech Alfred
12.00 - 12.30pm	The role of communication in fighting chronic aflatoxicosis induced decline in household productivity	Christine Elong
12.30 - 01.00pm	Aflatoxin in aquaculture systems: effects and mitigation attempts to reduce aflatoxin induced decline in fish.	Nakyewa Pauline
1.00 - 2.00PM	**LUNCH**	**Pacific Hotel resturant**
2:00m-2:15pm	Aflatoxin in livestock and its impact	Dr. Zziwa Emmanuel
2.15 - 2.30pm	Effect of Aflatoxin on Livestock productivity	Mr. Nviiri Geofrey

2.30 - 2.45pm	Managing aflatoxicosis in commercial livestock production systems	Dr. Swidik Mugerwa
2.45 - 3.00pm	**Group Discussions**: a) Strategies for local awareness creation on the aflatoxin problem b) Aflatoxin mitigation strategies with potential of adoption by farmers and other value chain actors c) Institutional arrangements and partnerships for aflatoxin awareness and management	Dr. Laban Turyagenda/Rapporteurs
3.15 - 3.30pm	**CLOSING REMARKS**	**Chief guest**
3.30 - 3.45pm	Summary of the meeting and way forward	All participants
3:45-4:00pm	Departure	

Annex 2

Participants

No	**Name**	**Designation**	**Contact.**	**Email address**
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16	Akera Patrick	DAO,gulu	0782351870	
17	Akona John Michael	DAO Oyam	0773222091	Akonaoyam@gmail.com
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