



Understanding and Managing Aflatoxin Contamination in the Groundnut Value Chain in Nigeria



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Institute for Agricultural Research (IAR), Nigerian Agricultural Seed Council (NASC), Centre for Dryland Agriculture of the Bayero University of Kano (CDA/BUK), Federal University of Agriculture, Makurdi (FUAM), Green Sahel Agricultural and Rural Development Initiative (GSARDI), Catholic Relief Services (CRS), Women Farmers Advancement Network (WOFAN) and the Agricultural and Rural Development Authorities of Kebbi, Sokoto, Jigawa, Kano and Katsina.

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FORWARD

This manual is conceived to support awareness raising campaigns of the groundnut value chain actors in and out of the States targeted for the implementation of the USAID funded Groundnut Technology Upscaling Project in Nigeria. It is a fall-out of two capacity development events of the project - Media Training and Training of Trainers Workshops organized by ICRISAT in Kano during the first six months of project implementation in Nigeria.

In view of the focus of the groundnut technology upscaling project on ensuring that farmers produce and market groundnuts free of Aflatoxins, the manual provides the general and specific information on Aflatoxin contamination and its management at all stages of the groundnut value chain. Though considered to be a basic companion document for front-line officers of partner institutions of the groundnut technology project, it can also be used by other actors of the groundnut value chain.

The Manual is laid out in two parts; while Part 1 provides general and specific information required for the understanding of Aflatoxin, Part 2 focuses on the management of Aflatoxins at all stages of the groundnut value chain.

The authors are grateful to all those who provided the technical materials from which the manual has been developed.

Part 1: UNDERSTANDING AFLATOXINS

Definition and Importance

Aflatoxin is a poisonous substance produced by toxigenic strains of two fungi: *Aspergillus flavus* and *Aspergillus parasiticus*. Aflatoxin-producing fungi are spread by wind, insects and decomposed soil wastes. These fungi are therefore present in air, soil and water. Once released, Aflatoxin-producing fungi are difficult to eliminate as they remain stable throughout some agricultural groundnut value chain i.e. from the farm through storage to the consumption of these commodities.

In spite of the nutritive and economic value of groundnuts, they are exposed to contamination by the fungi that produce Aflatoxins before, during and after harvesting, which affect their quality and safety for human consumption.

This brochure provides basic information for understanding Aflatoxin and the different techniques for ensuring that groundnuts consumed and/or sold on both national and international markets are free of Aflatoxin. The brochure is a technical support material for literate farmers, extension agents, agro-dealers, processors policy-makers of the groundnut value chain in and out of Nigeria.



Aspergillus flavus fungi

Key Message

By paying a little bit more attention to on-farm and post-harvest operations, actors of the groundnut value chain – farmers, extension agents, processors and policy-makers can effectively mitigate the Aflatoxin contamination.

Crop and Livestock Commodities Liable to Aflatoxin Contamination

- **Cereals:** maize, sorghum, millet, rice and wheat
- **Oil kernels:** groundnut, soybean, sunflower and cotton
- **Spices:** peppers and ginger
- **Nuts:** coconut
- **Livestock:** milk, cheese and butter
- **Roots and tubers:** cassava and cassava by-products

The Effects of Aflatoxin Contamination on Humans and Livestock

Human and livestock

- Excessive levels of Aflatoxin reduce the effectiveness of human immune system to fight against invasion by foreign agents with the primary organs being the liver, male reproductive organs, lungs, kidneys and the brains (Aflatoxicosis).
- It impairs normal growth in children.
- In poultry and livestock, excessive exposure to Aflatoxin reduces appetite, enhances weight loss, reduces egg production in poultry and contaminates animal by-products, especially milk.
- Sudden death of livestock (cattle, turkey, poultry, pigs, etc.).

Key Message

Considering that no level of Aflatoxin exposure is safe for human beings and livestock, sustained awareness campaigns of its prevalence and management are imperative.

Safety measures that avoid the exposure of human beings and livestock to Aflatoxin contamination should therefore become essential components of primary health care delivery.

Economic Implications of Aflatoxin Contamination

- Outright loss in human food and livestock feeds
- Less cash revenue from contaminated crops (if discovered)
- Reduced productivity of dairy cattle, chicken and turkey
- Increased costs of production due to the imperative for Aflatoxin testing
- Rejection of consignments destined for organised national and exports markets
- Banning from admission into international markets

Key Message

Several countries have regulations on acceptable levels of Aflatoxins. A number of commodities including groundnut and groundnut-based products are required to demonstrate acceptable levels of Aflatoxin contamination prior to export.

Effects and Implications of Aflatoxin Contamination

- Deterioration of pods and kernel quality due to continuous fungal growth
- Contaminated kernels are unfit for human and animal consumption
- Reduced price for the produce on local and international markets
- Causes decay in both seeds and non-emerged seedlings
- Less cash revenue from contaminated crops, when contamination is confirmed
- Reduced productivity of dairy cattle, chicken and turkey
- Increased costs of production due to the imperative for Aflatoxin testing
- Rejection of consignments destined for national and exports markets
- Banning of countries from admission into international markets

Ensuring that farmers place Aflatoxin free groundnut on Nigerian markets is one of the cardinal action point of the Groundnut Upscaling Project. Several countries, including Nigeria, already have limits for acceptable levels of total Aflatoxins in foods. For example, the acceptable level of Aflatoxin contamination for European Union countries for nuts, dried fruits, cereals and spices vary between 2-12 µg/kg and 4-15 µg/kg. In the United States, the acceptable limit is 20 µg/kg for all food commodities, except milk. In Australia and Canada the acceptable limit is 15 µg/kg for nuts.

While recognizing that there is no safe level for Aflatoxin exposure, the Standards Organization of Nigeria (SON), has set the acceptable limit for grain commodities at 4 ug/kg and 20 ug/kg and 4 ug/kg for *kulikuli*, a popular local groundnut cake.

Key Message

Many countries have regulations on acceptable levels of Aflatoxins. A number of commodities including groundnut and ground-based products are required to demonstrate acceptable levels of Aflatoxin contamination prior to export and/or consumption.

Aflatoxins in the Groundnut Value Chain

Groundnut is rich in protein, oil and micronutrients (iron and zinc). Its nutritional qualities complement that of cereals (sorghum, millet and maize). Consuming them together enriches food in-take. Aflatoxin contamination can:

- accelerate the deterioration of the quality of groundnut pods making them unsuitable for consumption by human beings, livestock or sale;
- enhance the deterioration of the quality of groundnut pods already attacked by other pests and diseases;
- reduce the value of groundnut and groundnut-based products meant for national and international markets.

Key Message

Though mouldy groundnut grains do not necessarily imply Aflatoxin contamination, they suggest high risk of Aflatoxin contamination.

Conditions Favoring the Occurrence of Aflatoxin

On the farm

- Presence of fungus in soil and air
- Use of susceptible varieties
- End-of-season moisture stress to the crop for more than 20 days
- Mean soil temperatures of 28-31°C in the pod zone
- Insect damage to pods by termites or pod borers
- Death caused by diseases (stem, root and pod rots) at pod maturity stage
- Nematode damage to the pod
- Delayed picking of pods after lifting/removal from the soil
- Growth cracks due to mechanical damage of pods at harvest
- Harvesting over-mature crop

During Storage

- Mechanical damage to the pod at the time of harvest
- Storage of the harvest when pod moisture is more than 8% or under high humidity conditions
- Storage of fodders/haulms with immature pods
- Damage to the pod by insects during storage
- Storing haulms with immature or small pods (they tend to contain more Aflatoxins)
- Wetting of stored pods due to high ground-moisture or roof leakage

During processing

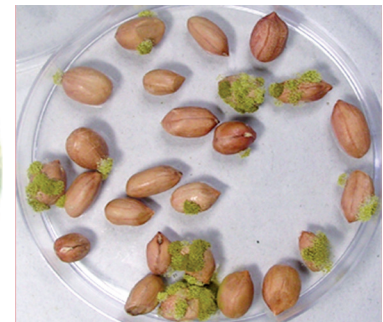
- Use of infected groundnut pods and/or as feeds for livestock
- Dirty or poor hygienic conditions of processing environments
- Use of dirty processing equipment
- Inadequate sampling for quality checks

Key Message

The excessive high and prolonged soil temperatures and the late season drought stress are the two most important conditions favouring Aflatoxin growth and eventual contamination of groundnut and groundnut-based products.

Other conditions are: insect damage, poor storage and associated growth of other fungi.

High levels of farm hygiene is the direct responsibility of groundnut producers in the management of Aflatoxin than the increasing unpredictable climatic variations of the Drylands.



Groundnut contaminated by *Aspergillus flavus*, responsible for Aflatoxin

Part 2: MANAGING AFLATOXIN CONTAMINATION

On-farm Management

- Use healthy improved and early maturing seed varieties
- Dress seeds with appropriate agro-chemicals before planting
- Remove dead plants and unhealthy plants especially before harvest
- Apply dry farm yard manure/between 2.5 and 3 t/h⁻¹ before planting
- Apply lime or gypsum (at 400 kg ha⁻¹ or 35 days after planting)
- Maintain at least 2 years of crop rotation in order to reduce the build-up of Aflatoxin producing fungi
- Avoid using farm from which maize, cotton, tobacco and tomatoes, have just been harvested - these crops are susceptible soil borne Aflatoxin producing fungi
- Avoid mechanical damage of pods during harvest
- Maintain recommended plant populations (33 plants per sq m)
- Control soil inhabiting insects such as termites
- Avoid end-of-season drought with irrigation, if possible
- Harvest the crop at right maturity
- Place lifted plants upside down for between 3 to 5 days
- Proper plowing before sowing

Management of On-farm Post-harvest Operations

- Dry the produce until the pod moisture is below 8
- Strip or thresh the pod immediately after drying and avoid stacking
- When using mechanical threshers, use appropriate sieves based on pod size so that immature pods are blown off
- Remove mechanical and insect damaged pods
- Separate the fully mature large pods (to be used for raw consumption) from the remaining produce (used for oil extraction)
- Regularly check during drying to remove damaged pods

Management of Off-farm Post-harvest Operations and Marketing

- Thoroughly clean storage facilities (containers and stores) before storage
- Prevent insect damage to the pods during storage
- Keep pod-filled bags on a wooden plank and store them in well ventilated, waterproof bags
- Remove pods in poor conditions before storage
- Avoid mixing dried pods with those just harvested from farm-fields
- Keep bags of pods in ventilated stores that do not have water infiltration
- If necessary, dry the stripped/threshed pods once again to maintain seed moisture below 8%
- Avoid entry of air and moisture into packaged groundnut-based products
- Avoid purchasing pods that have been stored for over three months
- Purchase unshelled groundnuts as the shells protect pods against moulds and insect invasion
- Spit out defective chewed pods with unwanted flavor during consumption
- Remove immature pods attached to haulms/fodder, if they are to be fed to animals
- Strive to acquire quality marks from appropriate national authorities such as *The National Agency for Food and Drug Administration and Control (NAFDAC)* and/or *The Standard Organization of Nigeria (SON)* before exporting.

Key Message

Unshelled groundnuts are better to purchase than shelled groundnuts as groundnut shells protect pods against moulds and insect attacks.



Set groundnut on a table for a better drying and conservation



Quality seeds



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