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Management of Aflatoxins in Maize and Groundnuts in Kenya

A Farmers' Training Manual

Joseph Atehnkeng, Charity Mutegi, Alejandro Ortega-Beltran, Joao Augusto Adebowale Akande, Lamine A. Senghor, Titilayo Falade, Juliet Akello, Peter J. Cotty Ranajit Bandyopadhyay

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Gearing up for impact
IITA 2018 Farmers' Guide to Management
of Aflatoxins in Maize & Groundnuts in Africa

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Abbreviations and Acronyms

EAC	East Africa Community
EU	European Union
FAO	Food and Agriculture Organization (United Nations)
GMPs	Good Management Practices
GAPs	Good Agricultural Practices
ICRASAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
KALRO	Kenya Agricultural and Livestock Research Organization
KEBS	Kenya Bureau of Standards
MoALF	Ministry of Agriculture, Livestock and Fisheries
ppb	Parts per billion
TOT	Training of Trainers

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Foreword

Aflatoxins are chemical poisons produced by fungi belonging to *Aspergillus* section *Flavi,* primarily *Aspergillus flavus*. These poisons cannot be seen with the naked eye and do not have a particular taste or odour. Hence, it is difficult to convince farmers and consumers about their presence in foods and feeds. The majority of farmers, traders and consumers in Africa are not aware of aflatoxin contamination of food and feed and its implications on trade, and human and livestock health. Measures that improve food quality both at household and market levels should be encouraged and implemented by stakeholders, especially the policy makers.

Aflatoxin contamination begins in the field and may increase during storage and transportation. This is because *Aspergillus flavus* resides in the soil, in living organisms, and dead and decaying matter. Factors influencing aflatoxin contamination include on- and off-farm crop handling practices, weather conditions during crop growth, plant susceptibility, and storage conditions. Maize and groundnut, staple crops for millions across East Africa, are most susceptible to aflatoxin contamination.

Awareness and sensitisation on aflatoxins to farmers, and all the stakeholders along the maize and groundnut value chains are therefore an important part of any intervention strategy to manage the problem. Increased awareness will enhance the adoption of the aflatoxin biocontrol technology ''aflasafe'' and other management practices available to minimise aflatoxin contamination.

Effective control of aflatoxin requires a combined approach of various technologies that have been proven to work. These include biological control, good agricultural practices (GAPs) and good manufacturing practices (GMPs). It is important that local personnel are trained to control factors that exacerbate aflatoxin contamination.

Documentation of farmers' current practices and training them on the code of practice in maize and groundnut production will improve crop quality. This entails monitoring and adoption of GMPs from preharvest to postharvest, and even during the processing and distribution of various products. It is also recommended that resources be directed to encouraging GAPs at the preharvest, harvesting, and postharvest levels.

The implementation of the guidelines contained in this manual will minimise aflatoxin contamination of maize and groundnuts through the adoption of biocontrol technologies and other preventive or control measures in the production, handling, storage and processing of the crops.

Dr Nteranya Sanginga
Director General, IITA

Dr Eliud Kiplimo Kireger
Director General/CEO, KALRO

1.0 Introduction

1.1.1 What are aflatoxins?

- Aflatoxins are natural poisons produced by the fungus (mould) *Aspergillus flavus* and closely related moulds.
- *Aspergillus flavus* naturally resides in soils on dead and decaying organic matter.
- Aflatoxins contaminate about 25% of the world's food production.[1]
- Other affected crops include chillies, cassava, sorghum, and rice.
- Aflatoxins pose health risks to both humans and animals even at low concentrations.
- Green growth of *Aspergillus* fungi on maize and on groundnuts is indicative of the likelihood of the presence of aflatoxins.

Photo 1: *Green growth of Aspergillus fungi on maize*

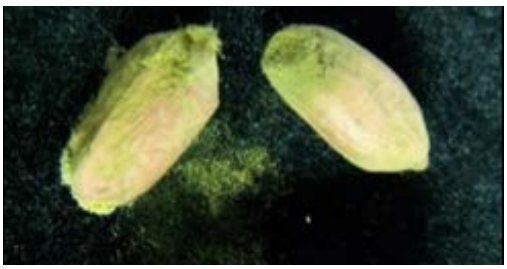


Photo 2: *Green growth of Aspergillus fungi on groundnut*

1.1.2 How do aflatoxins harm us?

- Aflatoxins cause liver cancer, suppress the immune system, retard growth anddevelopment in children.
- Consumption of aflatoxin-contaminated food and feed decreases productivity in humans and animals, due to their negative effect on health.
- Aflatoxins also reduce both crop value and business opportunities.
- Consequently, aflatoxin-contaminated crops typically are sold into low-value markets.

1.1.3 Can we see aflatoxins?

- Aflatoxins are colourless chemicals and cannot be seen with the naked eye.
- Therefore, grains without visible signs of yellow/green *Aspergillus flavus* may contain high amounts of aflatoxins.
- Aflatoxin concentrations are determined using laboratory tests.

1.1.4 Where and how are aflatoxins produced?

- *Aspergillus* moulds produce aflatoxins when they infect grains before, during, and after harvest.
- Insect damage increases fungal growth and aflatoxin contamination.
- Drought and high temperatures increase aflatoxin production, as do improper pre-harvest, post-harvest, and storage practices.

1.1.5 Occurrence of aflatoxins

- *About 25% of maize and groundnuts become contaminated with aflatoxins*
- *Over 4.5 billion people are regularly exposed to dangerous aflatoxin concentrations.*[2]

[1.] E. Boutrif, 'Prevention of aflatoxin in pistachios' http://www.fao.org/docrep/w9474t/w9474t06.htm (accessed 6 March 2018).

[2.] Centre for Disease Control and Prevention https://www.cdc.gov/nceh/hsb/chemicals/aflatoxin.htm (accessed 5 March 2018).

1.1.6 Effect of aflatoxins on health

- Aflatoxins are linked to cancer (especially of the liver), immune system suppression, child stunting, impaired food conversion, kidney toxicity, and when consumed in large quantities, can cause death.
- Exposure to aflatoxins may start before birth. Mothers can pass aflatoxins to the foetus through the umbilical cord.

1.1.7 Effect of aflatoxins on trade

- Aflatoxins are strictly monitored in crops sought by domestic and international premium markets. This is due to the dangerous effects on human and animal health,
- Trade opportunities and incomes are therefore lost as a result of the rejection of aflatoxin contaminated food.

» In Kenya, the regulatory threshold is 10 parts per billion (ppb) of total aflatoxin, and 5 ppb of aflatoxin B1 Foods containing aflatoxin levels above should not be consumed.

» European nations, on the other hand, have set a limit of 4 ppb of total aflatoxin and 2 ppb of aflatoxin B1 for food crops. The limit in the US for total aflatoxin is 20 ppb. Across Africa it varies from 10 to 20 ppb.

Illustration 1: *High aflatoxin content reduces income from groundnuts*

1.1.8 Can we reduce aflatoxin contamination?

- Yes. The best way to reduce aflatoxin contamination in maize and groundnut produce is to use an integrated management approach.
- We combine proven technologies which are described in Part I.

Part I

Pre- and post-harvest interventions for maize

2.0 Interventions for maize

2.1 Awareness raising and training

Illustration 2: *Organise farmers' field days for demonstration*

Illustration 3: *How to identify diseased cobs*

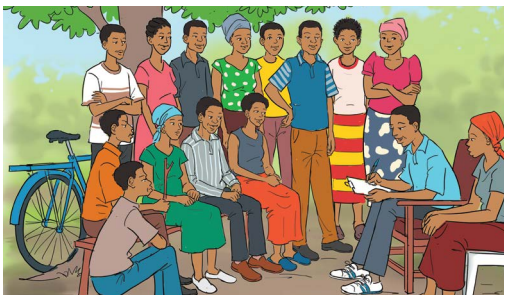


Illustration 4: Training of farmers

Illustration 5: Awareness campaigns for farmers across Africa

Illustration 6: *Creating awareness with regulators and farmers*

Illustration 7: *Training farmers in a classroom setting*

2.2 Pre-harvest interventions

2.2.1 Sources of inputs

Obtain good quality and certified seeds for planting. All other inputs such as fertilizers, pesticides, and herbicides should be obtained from an agro-dealer or authorised sources.

Illustration 8: *Use seeds recommended for your area*

Illustration 9: *Use recommended chemicals*

2.2.2 Follow good agronomic practices during crop growth

i) Timely planting

- Plant at the right time to ensure the crop escapes disease, and has enough rain for growth and maturity until the end of the season.
- Avoid dry planting (early planting) to prevent crops maturing during the rains.

» Planting on time and timely application of inputs will enable maize to grow healthy and resist pests and diseases.

Photo 3: *A well-managed maize field*

Photo 4: *A poorly managed maize field*

ii) Use improved varieties

- Contact extension agents to know which varieties perform better in your area.

Photo 5: *Plant maize varieties recommended in your area. Contact extension agents for advice*

iii) Apply the correct fertilizer and other inputs

- Apply the correct fertilizer based on the soil needs.
- Apply appropriate inputs in a timely manner.

Illustration 10: *A farmer applying fertilizer on his maize field*

- Crops grown under stress are more susceptible to infestation by the aflatoxin-producing fungi.
- Applying fertilizer and other key inputs reduces stress.
- If possible, irrigate the farm during dry spells.

iv) Control pre-harvest pest damage

- Control insects, particularly the stem borer, fall army worm and aphids during crop growth using recommended pesticides.
- Insects create wounds on the crop that lead to invasion by fungi. Sometimes insect attack may completely damage the crop.

Photos 6 and 7: *Crops damaged by insects*

v) Weeding

- Timely control of weeds is important because it reduces competition.
- Weed control can be done manually with a hoe or oxen.
- You may also use herbicides.

Illustration 11: *Weed fields on time*

vi) Aflasafe KE01 application

What is aflasafe and how does it work?

- Aflasafe KE01 contains four *Aspergillus flavus* strains native to Kenya.
- Roasted, sterile sorghum grains serve as carriers and nutritive source for the non-poisonous strains of the *Aspergillus flavus.*
- Spores of these strains are coated on to sorghum using a polymer sticker.
- A blue food dye is used to distinguish aflasafe KE01 from seed sorghum and sorghum used as food.
- The beneficial strains of aflasafe KE01 require moisture to grow, therefore apply aflasafe KE01 after rains, when rains are expected or when the soil is wet. When there is adequate moisturein the soil, aflasafe KE01 non-poisonous strains grow rapidly on the sorghum grain carrier which serves as their food.
- The non-poisonous strains of aflasafe KE01 produce spores on sorghum grains 5-15 days after application.
- After the initial reproduction cycle, thenon-poisonous strains will colonise organic matter in the field before moving to the target crops.
- This will prevent toxigenic fungi from colonising the groundnuts.

Photos 8 and 9: *The non-poisonous strains of aflasafe produce spores on sorghum grains 5-15 days after application*

- Application of aflasafe has carryover effects and is beneficial for maize and groundnut intercrop. The non-poisonous *Aspergillus flavus* strains of aflasafe do not have adverse effects on other crops.
- Treated crops have significantly less aflatoxins than untreated crops. Aflatoxin-safe crops have higher chances of being commercialized in premium markets.

vii) How to use aflasafe KE01

- Before application of aflasafe KE01, ensure that all agronomic practices (like weeding, fertilizer application) have been undertaken.
- Apply aflasafe KE01 in maizefields at least 2–3 weeks before flowering, or at the 7th leaf stage.
- Broadcast at the rate of 4 kg per acre.

Photo 10: *Right stage of the crop for aflasafe KE01 application*

- Applying aflasafe KE01 when maize plants have already flowered is not effective in reducing aflatoxin accumulation.

Photo 11: *Wrong stage of aflasafe application*

- Ensure that all weeding is done before aflasafe KE01 application. This will ensure that the aflasafe KE01 is not trampled on or buried during the process of weeding.

Photo 12: *Delayed weeding is not good for aflasafe KE01 application*

- Ensure that aflasafe KE01 is distributed uniformly in the field during application.

Photo 13: *A farmer hand-broadcasting aflasafe KE01 in a maize field*

- aflasafe KE01 can also be applied in a groundnut field that is intercropped with maize or other crops.

Illustration 12: *Application of aflasafe KE01 in mixed cropping*

viii) Precautions

Photo 14: *aflasafe KE01*

1. Do not apply aflasafe KE01 at the same time with fertilizers, insecticides, or fungicides.
2. Apply aflasafe KE01 only when the possibility for drift to potential sensitive areas (e.g., residential areas, water bodies, known habitat for threatened or endangered species) is minimal.
3. Do not expose aflasafe KE01 to a relative humidity greater than 80% prior to use.
4. This product contains living organisms that must be alive to work. Do not expose to temperatures above 50°C.
5. Use all product of this package by applying according to directions.
6. Do not use empty packaging to store food for human consumption.
7. Assemble the bags and contact the manufacturer for further disposal instructions.
8. Do not apply to areas where surface water is present.

2.3 Harvesting

- Timely harvest of crops limits aflatoxin contamination. Harvest immediately after the crop is mature. Pluck the cobs off the plant and dry to less than 13% moisture content without delay.

Photos 15 and 16 : *Harvest maize ears while the plants are still standing*

Photo 17: *Insect or bird damaged maize*

Photo 18: *Delayed harvesting leads to unhealthy infestations*

- Delayed harvesting may lead to infestation by dangerous moulds and attack by birds and insects.

2.3.1 Lodging

- Maize plants that have fallen on the ground (lodged) should be lifted up and tied together.

Photo 19 and 20: *The lodged maize plant should be lifted up*

2.3.2 Sorting of damaged cobs

- During harvesting, separate cobs damaged by birds or rodents.
- Damaged crops may have been infected by aflatoxin-producing fungi and may contain high aflatoxin content.

Photos 21 and 22: *Crops damaged by rodents and birds*

2.3.3 Heaping

- Farmers often heap the maize plants in the field to allow for drying.

Illustration 13: *Maize plants in cone-shaped heap*

- The heaps should remain erect in the form of a cone.
- Heaps that are too big or that fall on the ground are likely to accumulate moisture at the centre.

Photo 23: *When maize is heaped on the ground, it accumulates moisture*

- Do not heap plants that have been lying on the ground for a long period and/or have signs of animal/insect damage.

Photos 24 and 25: *Insect or animal damaged plants should not be heaped*

2.3.4 Dehusking

- Dehusk the cobs directly into a water proof bag or container and avoid contact with the soil.
- Seal as soon as possible.

Illustration 14: *Cobs should be packed into sealable waterproof bags and containers to keep off moisture*

Photo 26: *Do not put stripped or dehusked cobs on bare ground*

Photo 27: *Do not put stripped or dehusked cobs on bare ground*

2.4 Post-harvest management

2.4.1 Drying

- Drying of maize cobs should be done on a tarpaulin or mat and NEVER on the bare ground. REMEMBER that *A. flavus* resides in the soil and therefore chances of cob contamination are high if in contact with the soil.
- During drying, sort to remove immature cobs, infected, diseased cobs/grains, debris and broken cobs.

Photo 28: *Sorting of maize during harvest on polyethylene sheets, or tarpaulin*

Photo 29 and 30: *Dry grain on polyethylene sheets or tarpaulin*

Illustration 15: *Dry maize in elevated platforms. Cover with polyethylene sheets to protect grains from rain*

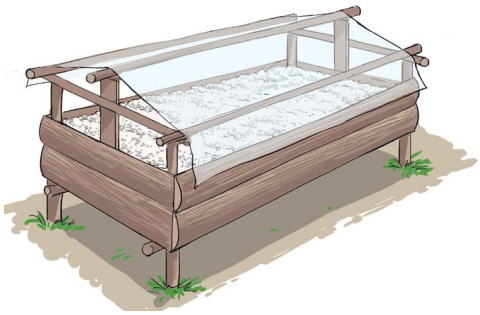


Illustration 16: *Tray dryer for natural drying of maize. The tray has a mesh-wire bottom and a pitched roof cover with transparent polyethylene sheet to allow the grains to be exposed to sunlight*

Illustration 17: *Do not dry maize produce on tarmac*

Illustration 18: *Ensure that produce does not come into contact with water during drying*

2.4.2 Sorting

Separate the healthy cobs from immature, insect damaged or diseased cobs.


Photo 31 and 32: *Healthy maize cobs*


Photo 33 and 34: *Unhealthy, infested cobs should be separated from healthy cobs*

2.4.3 Check the moisture content of the grain

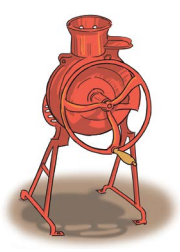
Use a moisture meter to know the moisture content of your maize. Alternatively, farmers can test for properly dried maize by cracking kernels between the teeth.

If it shatters, then kernels are dry. If it is sticky, then kernels are not dry. Also, farmers can throw maize up and down their palms, or inside a bottle. Dry maize will produce a rattling noise, compared to maize that is not well dried.


Photo 35 and 36: *Checking moisture in grain*

2.4.4 Threshing/Shelling

Use well-calibrated threshers to avoid breaking the grains and lowering the quality of the produce.

Illustrations 19 and 20: Calibrate machine before threshing. Poorly calibrated threshers damage kernels

Photo 37: *Thresh on tarpaulin and maintain good hygiene during threshing and bagging of maize*

Photo 38: *Threshed whole grains of good quality*

Illustration 21: *Wooden, hand-held maize sheller reduces proportions of broken kernels*

Photo 39: *Do not thresh maize by beating with sticks. This may increase breakage of kernels*

Photo 40*: Do not winnow maize on bare ground*

2.4.5 Storage

- Clean, repair and disinfect the storage structure before bringing in the new harvest.
- Fumigate the storage structure to control insects and rodents.
- Storage structure should have well-built wall and roof to prevent rain seepage and excess moisture in the facility.
- The structure should be well ventilated, with low relative humidity.
- Wooden pallets can be used to raise storage bags, and create a distance between bags and walls to allow for proper aeration.
- Do not mix new and old crops.

Photo 41: *Stack bags of maize properly on wooden pallets. Avoid contact with the wall or the floor.*

Illustration 22: *A well-built storage structure*

Photo 42: *A poorly built storage structure*

Photo 43: *Poor sanitation practices in storage*

2.4.6 Transportation

Transport maize in waterproof vehicles to avoid re-wetting. If the truck is open ensure that the bags are covered with a waterproof cover on all sides.

Illustration 23: *Produce should be arranged neatly on wooden pallets when transporting*

Illustration 24: *Transporting without a waterproof cover in humid or rainy conditions allows wetting of the produce. Fungal infection and aflatoxin contamination will probably occur.*

Part II

Pre- and post-harvest interventions for groundnuts

3.0 Interventions for groundnuts

3.1 Awareness Raising /Training

Illustration 25: *Organise farmers' field days for demonstration*

Illustration 26: *Farmers being trained on identification of diseased pods or plants*

Illustration 27: *Training of farmers*

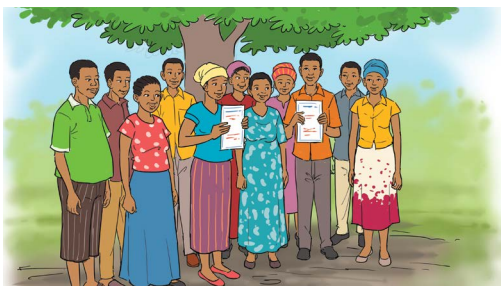


Illustration 28: *Awareness campaigns for farmers across Africa*

Illustration 29: *Creating awareness with regulators and farmers*

Illustration 30: *Training of farmers in a classroom setting*

3.2 Pre-harvest interventions

3.2.1 Sources of inputs

- Obtain good quality and certified seeds for planting. All other inputs such as fertilizers, pesticides, and herbicides should be obtained from an agro-dealer or authorised sources.
- Source the seeds in time so that you are not late for planting.

Illustration 31: *Use seeds recommended for your area*

Illustration 32: *Use recommended chemicals*

3.2.2 Follow good agronomic practices during crop growth

i) Timely planting

- Plant at the right time to enable crop-disease escape, and have enough rainfor growth and maturity towards the end of the season.
- Avoid dry planting (early planting) toprevent crops maturing during the rains.
- Timely planting and application of inputs will enable groundnuts to grow healthy and resist pest and diseases.

Photo 44: *A well-managed groundnut field*

Photo 45: *A poorly managed groundnut field*

ii) Use improved varieties

- Contact extension agents to know which varieties perform better in your area.
- Plant groundnut varieties recommended for your area.
- Contact extension agents for advice.

iii) Apply the correct fertilizer and other inputs

- Apply the correct fertilizer based on the soil needs.
- Apply other inputs in a timely manner.

Illustration 33: *Farmer applying organic fertilizer on his groundnut field*

- Crops grown under stress are more susceptible to infestation by the aflatoxin-producing fungi.
- Avoid any form of crop stress during the crop growth. Applying fertilizer and other key inputs reduces crop stress.
- If possible, irrigate the farm during the dry spells.
- Use of tied ridges (Photo 45) and mulching (Photo 46) practices help to conserve moisture and reduce stress in the plant reducing aflatoxin contamination.

Photo 46: *Tied ridges practices. Photograph from Dr. Sam Njoroge, ICRISAT*

Photo 47: *Mulching practice. Photograph from Dr. Sam Njoroge, ICRISAT*

iv) Control pre-harvest pest damage

- Control insects during crop growth.
- Insects create wounds on the crop that lead to invasion by fungi. Sometimes insect attacks may completely damage the crop.

Photo 48: *Insect damage on leaves*

v) Weeding

- Timely control of weeds is important. It reduces competition with the crop.
- Weed control can be done manually with a hoe or oxen.
- You may also use herbicides.

Photo 49: *Weed fields on time*

vi) Use improved varieties

Contact extension agents to know which varieties are recommended in your area.

Photo 50: *Plant groundnut varieties recommended in your area*

Illustration 34: *Contact extension agents for advice*

vii) Aflasafe KE01 application

What is aflasafe and how does it work?

- Aflasafe KE01 contains four *Aspergillus flavus* strains native to Kenya.
- Roasted, sterile sorghum grains serve as carriers and nutritive source for the non-poisonous strains of the *Aspergillus flavus.*
- Spores of these strains are coated on to sorghum using a polymer sticker.
- A blue food dye is used to distinguish aflasafe KE01 from seed sorghum and sorghum used as food.
- The beneficial strains of aflasafe KE01 require moisture to grow, therefore apply aflasafe KE01 after rains, when rains are expected or when the soil is wet.

When there is adequate moisturein the soil, aflasafe KE01 non-poisonous strains grow rapidly on the sorghum grain carrier which serves as their food.

- The non-poisonous strains of aflasafe KE01 produce spores on sorghum grains 5-15 days after application.
- After the initial reproduction cycle, thenon-poisonous strains will colonise organic matter in the field before moving to the target crops.
- This will prevent toxigenic fungi from colonising the groundnuts.

Photos 51 and 52: *The non-poisonous strains of aflasafe KE01 produce spores on sorghum grains 2-3 days after application*

- Application of aflasafe KE01 has carryover effects and is beneficial for maize and groundnut intercrop.
- The non-poisonous *Aspergillus flavus* strains of aflasafe KE01 do not have adverse effects on other crops.

How to use aflasafe KE01

- Before aflasafe KE01 application ensure that all agronomic practices (weeding, last dose of fertilizer applied, etc.) have been completed.

Photo 53: *Weed fields on time before aflasafe KE01 application*

Photo 54: *Ensure that the crop is at the right stage before aflasafe KE01 application*

Illustration 35: *Broadcasting aflasafe KE01*

- Apply aflasafe KE01 in groundnut fields 30 to 45 days after planting.
- Ensure that aflasafe KE01 is distributed uniformly in the field during application
- Broadcast at the rate of 4 kg/acre.

Photo 55*: Wrong stage of aflasafe application*

- Application of aflasafe KE01 when groundnut plants have already flowered will not be effective in reducing aflatoxin accumulation.

Photo 56: *Groundnut field with weeds*

- Delayed weeding is not proper for aflasafe KE01 application.
- aflasafe KE01 can also be applied in a groundnut field that is intercropped with maize or other crops.

Illustration 36: *Broadcasting aflasafe KE01 in mixed cropping*

3.3 Harvesting

- Harvest groundnuts immediately after they have reached maturity.
- Delayed harvesting promotes fungal infection and subsequent aflatoxin production.
- If left on the field longer than necessary, some groundnut varieties can germinate, especially if it is still raining.
- Take care to avoid mechanical injury on pods during harvesting.

Photo 57: *Intact pods with no fungal infection*

Photo 58: *Infected sprouted pods due to delayed harvesting*

Photo 59: *Pods break and allow moulds to infect the grains*

Photos 60 and 61: *Damaged groundnut pods*

Photo 62: *Harvest with care to avoid mechanical injury on pods*

- Pick the pods into a container. Damaged groundnut pods allow infection of bad moulds.

3.4 Post-harvest management

3.4.1 Drying

- Tie a few groundnut plants together and place on the ground with the pods facing upward for fast drying.

Illustration 37: *Inverted groundnut plants for drying*

- Dry groundnuts on structures like the A-frame before picking.

Photo 63: *A farmer drying groundnuts on the A-frame*

- Do not dry groundnuts in a heap on the ground. The surface may look dry, but the centre may accumulate moisture.

Illustration 38: *Heaped groundnuts*

- Dry groundnuts on polyethylene sheets.

Illustration 39: *Drying groundnuts on polyethylene sheet*

3.4.2 Sorting

- Separate healthy pods from immature, insect damaged or diseased pods.

Illustration 40: Sorting healthy pods from damaged or diseased pods

3.4.3 Threshing/Shelling

- Threshing should not be done on bare ground

Photo 64: *Threshing on tarpaulin*

Photos 65 and 66: *Threshing and storing on the bare ground increases risks of contamination*

- After threshing, sort groundnut to remove damaged/discoloured or diseased grains before cooking or storage.
- Maintain good sanitation

Photo 67: *Goats trampling and eating threshed groundnuts*

3.4.4 Storage

- Clean, repair and disinfect the storage structure before bringing in the new harvest.
- Fumigate the storage structure to control insects and rodents.
- The storage structure should have a well-built wall and roof to prevent rain seepage and excess moisture.
- The structure should be well ventilated, with low relative humidity.
- Do not mix new produce with old.

Photo 68: *Well stored groundnut bags*

- Groundnut bags should not be put on the ground or touch walls.
- Neatly stack bags on wooden pallets

Photo 69: Poorly stored groundnut bags

- Prolonged inappropriate storage results in groundnut deterioration and increased aflatoxin content.

Photo 70: *Damaged groundnuts as a result of prolonged storage*

3.4.5 Transportation

- Transport groundnuts in waterproof vehicles to avoid re-wetting.
- If the truck is open ensure that the bags are covered with a waterproof cover on all sides.

Illustration 41: *Produce should be arranged neatly on wooden pallets*

- If it rains, this type of transport would allow re-wetting of the crop and fungal infection and aflatoxin contamination will probably occur.

Illustration 42: *ransporting without a waterproof cover in humid or rainy conditions allows wetting of the produce. Fungal infection and aflatoxin contamination will probably occur*

4.0 OTHER ASPECTS

4.1.1 Decontamination

Even after all preventive pre- and post-harvest measures have been put in place, there is still a chance of some of the produce getting contaminated. Heavily contaminated maize can be incinerated to ensure it is not inadvertently consumed.

Ammoniation (use of ammonia to treat maize contaminated by turning the aflatoxin into a less toxic compound) can also be used. However, the maize that is treated in this way should be used for livestock and poultry feed, and not for human consumption.

4.1.2 Standards

The Kenya Bureau of Standards (KEBS) is the government body that is mandated to develop aflatoxin standards in Kenya. KEBS does this in consultation with various actors such as the Public Health Department, under the Ministry of Health, Ministry of Agriculture Livestock and Fisheries (MoALF), and universities.

KEBS carries out evidence-based risk assessment to set standards. The regulatory threshold for aflatoxin in maize and peanuts is 10 ppb for total aflatoxin and 5 ppb for aflatoxin B1, the most potent of the aflatoxins. The East African Community (EAC) has also developed standards that are supposed to be adopted by East Africa member states. The table below summarizes these standards in various key commodities.

4.1.3 Aflatoxin Standards

Recently adopted EAC MLs

Recently adopted EAC MLs.* EAC Number	Foodstuff	Total aflatoxins (µg/kg)	Aflatoxin B1(µg/kg)
EAS 2:2012	Maize grain	10	5
EAS 46:2012	Dry beans	10	5
EAS 51:2012	Wheat	10	5
EAS 128:2012	Milled rice	10	5
EAS 284:2012	Pearl millet**	10	None***
EAS 331:2012	Green gram	10	5
EAS 754:2012	Chickpeas	10	5
EAS 755:2012	Cowpeas	10	5
EAS 756:2012	Dry pigeonpeas	10	5
EAS 757: 2012	Sorghum grains	10	5
EAS 758:2012	Finger millet (*Eleusine coracana*)	10	5
EAS 759:2012	Dry whole peas (*Pisum sativum/arvense*)	10	5
EAS 760	Lentils	10	5
EAS 761:2012	Dry split peas	10	5
EAS 762:2012	Dry soybeans	10	5
EAS 763: 2012	Dry faba beans	10	5
EAS 764:2012	Rough (paddy) rice	10	5
EAS 764:2012	Brown rice	10	5

* EAC Secretariat Standards Office
** Whole and decorticated Senegalese varieties of *Pennisetum*
*** No limit recomended

4.1.4 Capacity Building

Insufficient capacity in disseminating the requisite information poses a major challenge in effecting control strategies, particularly those requiring technical know-how.

The regional mycotoxin facility at the Kenya Agricultural and Livestock Research Institute (KALRO) in Katumani offers various categories of training to extension officers, drawn from public and private sectors. Other institutions involved in developing capacity in this area can be provided to trainees on request.

4.4.5 Policy

The development of a policy and legal framework to formalize the control strategies is critical. In order to validate various viable control strategies for aflatoxin and avail them for use under a legal framework, policy development is critical in this regard. The EAC secretariat partnered with IITA to develop technical papers on various aspects of aflatoxin management.

These have since been discussed within the EAC legislative assembly and policy briefs have been developed covering various areas:

- Aflatoxin and human health;
- Hepatitis A and B;
- Aflatoxin and the 1000 days;
- Impact on animal health and productivity;
- Biocontrol for aflatoxin;
- Aflatoxin and post-harvest losses;
- Aflatoxin standards for foods;
- Aflatoxin standards for feed; and
- Five-year communication strategy for an aflatoxin safe East Africa community.

These policy briefs can be accessed on
https://aflasafe.com/resources/policy-briefs/

Notes

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