Integrated Groundnut Aflatoxin Management

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ICRISAT- West and Central Africa

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Presentation Outline

1. The groundnut aflatoxin problem in the Semi-Arid Tropics – examples from Mali

2. ICRISAT’s approach for integrated management of aflatoxin

3. Prioritising future AR4D interventions
Where do the important legumes grow?
Food insecurity and chronic malnutrition, Land degradation, poor soil fertility, pests & diseases; Frequent drought and high temperatures; Socio-political instability
<table>
<thead>
<tr>
<th>Aflatoxin</th>
<th>Kolokani</th>
<th>Kita</th>
<th>Kayes</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection rate (%)</td>
<td>85.55</td>
<td>88.88</td>
<td>91.66</td>
<td>88.70</td>
</tr>
<tr>
<td>Mean (ppb)</td>
<td>108.5</td>
<td>45.1</td>
<td>27.1</td>
<td>60.2</td>
</tr>
<tr>
<td>Range</td>
<td>0-1678</td>
<td>0-246</td>
<td>0-217</td>
<td>0-1678</td>
</tr>
</tbody>
</table>

Mean aflatoxin (ppb) in farmers fields at harvest, in 3 regions of Mali, Nov, 2009 to June, 2010
Aflatoxins contamination in 30 farmers’ granaries

Kolokani region

Sampled period

Mean AFB content

Farmers’ fields
Granaries
Traders
Markets
Mean aflatoxin (ppb) in samples from traders, in Kolokani and Bamako, Dec 2009 to February 2011

<table>
<thead>
<tr>
<th>Aflatoxin</th>
<th>Kolokani</th>
<th>Bamako</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection rate (%)</td>
<td>93.85</td>
<td>96.13</td>
<td>95</td>
</tr>
<tr>
<td>Mean (ppb)</td>
<td>132.6</td>
<td>111.3</td>
<td>122</td>
</tr>
<tr>
<td>Range</td>
<td>0-1823</td>
<td>0-2231</td>
<td>0-2231</td>
</tr>
</tbody>
</table>
Market survey for aflatoxin contamination in Kolokani region*

*Mean aflatoxins levels (µg/kg) in 5 markets for the targeted villages in Kolokani region
An Integrated Approach to Manage Aflatoxin Contamination

Global Approach

HOST RESISTANCE
- Conventional breeding
- Transgenic approaches i.e. anti-fungal and anti-mycotoxin genes

CULTURAL PRACTICES
- Soil amendments
  - e.g. gypsum, compost

BIO-CONTROL AGENTS
- Trichoderma, Pseudomonads, Atoxigenic strains

HARVEST AND POST-HARVEST TECHNOLOGIES
- Drying and Storage

Technology Transfer / Socioeconomic Issues
- Regional studies & monitoring
- Public Awareness
- Trade implications
- Advisory panels
- Consultation to Industries
- Strengthening Capacity

Assessment / Implementation at Regional level
- Devising appropriate regional packages and promotion
- No-cost
- Low-cost
- High-cost

Pre- and Post-harvest Aflatoxin Management

- Host Resistance
- Cultural Practices
- Bio-control Agents
- Harvest and post-harvest technologies
Testing and transferring resistant improved varieties to farmers

2500 germplasm lines screened and sources of resistance to pod wall, seed coat and cotyledon identified in cultivated peanut

• Many varieties show high levels of resistance across tests, locations
• Resistance needs to be combined with integrated management

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Aflatoxin (ppb)</th>
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</thead>
<tbody>
<tr>
<td>ICGV 89092</td>
<td>0.2</td>
</tr>
<tr>
<td>ICGV 91289</td>
<td>0.4</td>
</tr>
<tr>
<td>ICGV 00362</td>
<td>0.7</td>
</tr>
<tr>
<td>ICGV 86168</td>
<td>0.7</td>
</tr>
<tr>
<td>ICGV 02313</td>
<td>0.9</td>
</tr>
<tr>
<td>ICGV 91283</td>
<td>1.2</td>
</tr>
<tr>
<td>ICGV 06423</td>
<td>1.5</td>
</tr>
<tr>
<td>ICGV 99240</td>
<td>1.8</td>
</tr>
<tr>
<td>ICGV 07220</td>
<td>2.1</td>
</tr>
<tr>
<td>ICGV 91324</td>
<td>2.1</td>
</tr>
<tr>
<td>ICGV 01258</td>
<td>2.5</td>
</tr>
<tr>
<td>ICGV 91278</td>
<td>2.7</td>
</tr>
<tr>
<td>ICGV 93305</td>
<td>2.8</td>
</tr>
<tr>
<td>ICGV 91317</td>
<td>3.4</td>
</tr>
<tr>
<td>ICGV 89106</td>
<td>3.9</td>
</tr>
<tr>
<td>ICGV 91304</td>
<td>3.9</td>
</tr>
<tr>
<td>ICGV 89115</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Demonstration of simple and affordable Good Agricultural Practices (GAP’s) to mitigate aflatoxin contamination in groundnut

**Pre-harvest**

- Farmyard manure @2tons / per acre
- Applying Trichoderma culture to soil @ 1 kg/per Hectare
- Seed treatment with dithane M 45@3g/kg
- Applying gypsum @200kg /per acre
- Care should be taken while doing inter cultivation practices
- Avoid end of season drought with supplementary irrigation
- Harvest the crop at optimum maturity

**Post-harvest**

- Damage to the pods at the time of harvest should be avoided.
- Do not keep the harvested material on soil for longer time.
- Dry the stripped pods to less than 10% moisture (around 8% is better)
- Sun drying before and/or after pod-stripping should be done.
- Do not dry the diseased / infected produce along with healthy ones.
- Use new / clean gunny or poly bags to store the groundnuts
### Percent reduction by single or multiple cultural practices

<table>
<thead>
<tr>
<th>Agronomic practice</th>
<th>Aflatoxin reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal crop residues</td>
<td>53%</td>
</tr>
<tr>
<td>Farm Yard Manure (FYM)</td>
<td>59%</td>
</tr>
<tr>
<td>Lime</td>
<td>68%</td>
</tr>
<tr>
<td>Combination of FYM and residues</td>
<td>74%</td>
</tr>
<tr>
<td>Combination of lime and residues</td>
<td>81%</td>
</tr>
<tr>
<td>Combination FYM and lime</td>
<td>84%</td>
</tr>
<tr>
<td>Combination of FYM, lime and residues</td>
<td>85%</td>
</tr>
<tr>
<td>Sorting</td>
<td>90%</td>
</tr>
</tbody>
</table>
Development and use of detection technologies

- Developed test kits for screening and quantification of 4 mycotoxins (Aflatoxin B1, Aflatoxin M1, Ochratoxin A, Fumonisin B1) individually
- Developed competitive ELISAs
  - Indirect Competitive ELISA
  - Direct Competitive ELISA
- Supported establishment of mycotoxin testing labs in India, Kenya, Mali, Malawi, Mexico, Mozambique and Nigeria
- Hold annual International Training Courses - next year West Africa
Prioritising future R4D interventions

• Strengthen diagnostics for aflatoxins, including their accessibility
• Increase local knowledge of the extent of the aflatoxin problem in specific areas
  – soil sampling; toxigenic profiles; relationship with farmer practices;
  – Monitor agricultural commodity value chains to devise management strategies
  – Identify high risk populations
• Undertake further adaptive research to develop and promote innovative best bet management techniques
• Strengthen partnerships (PS- FO- Governments) to provide incentives for aflatoxin management
Thank you!

- A4NH, the CGIAR Research Program on Agriculture for Nutrition and Health - a4nh.cgiar.org
- CRP GrainLegumes
- Other partners

ICRISAT is a member of the CGIAR Consortium