Maize Stored Pests Control by PICS-Bags: Technological and Economic Evaluation

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Outline

1. Introduction
2. Traditional storage system
3. PICS bag trial
4. Key Results
5. Conclusion
6. Acknowledgements
Traditional storage system

- Environmental conditions, traditional farming methods and improper grain drying and storage practices facilitate quality reduction and insect infestation
- Grain losses due to Insects
  - >30% in maize stores infested with *Prostephanus truncatus*
  - 10-12 % in maize infested with *Sitophilus zeamais*

- Several African staple commodities are affected by high losses due to insects – maize, millet, groundnut, cassava, sorghum and processed yam and cassava products
- Post-harvest Loss Network determined losses for cereals to range between 17.4% to 14.3% (2003 till 2008)
PICS bag trial

- Storage of 25 kg of maize variety QPM in PICS bags and woven polypropylene bags as control
- HALF the bags artificially infested with 25 adults of *P. truncatus*
- Destructive sampling after 3 and 6 months
- Moisture content, insect species, grain losses, holes on bags determined
- Cost/benefit analysis to determine financial profitability

![PICS bag](image)

Moisture content in PICS bags (PsB) and Polypropylene Bags (PPB)

![Graph showing moisture content over time](image)
Effect of PICS Bag (PsB) on maize post-harvest pest after 3- and 6-month storage

<table>
<thead>
<tr>
<th>Treatment</th>
<th>3 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>PsB (natural)</td>
<td>0.75 ± 0.75</td>
<td>0.50 ± 0.50</td>
</tr>
<tr>
<td>PsB (artificial)</td>
<td>0.00 ± 0.00</td>
<td>1.25 ± 0.75</td>
</tr>
<tr>
<td>PPB (natural)</td>
<td>308.50 ± 36.39</td>
<td>322.25 ± 19.74</td>
</tr>
<tr>
<td>PPB (artificial)</td>
<td>344.25 ± 40.53</td>
<td>350.75 ± 25.38</td>
</tr>
</tbody>
</table>

• Both bags significantly reduced maize post-harvest insect densities when compared to the control polypropylene Bags (PPB) (P = 0.018), except for P. truncatus after 3 months of storage (P > 0.05).

• While the pest densities remained statistically identical in PsB and ISB, densities of C. quadricolis and Tribolium sp. increased significantly with sampling date (P < 0.0001).
Effect of PICS Bag (PsB) on maize post-harvest pest after 3- and 6-month storage period

- Pest densities was significantly reduced in PsB compared to PPB in 3- and 6-month storage period for S. zeamais, C. quadricollis and Tribolium spp. and 6-month storage period for P. truncatus (P = 0.018).

- Storage time did not affect insect densities in PsB (P = 0.111) however, in control bag except for P. truncates and S. zeamais, C. quadricollis and Tribolium spp. densities increased significantly with storage time (P < 0.0001).

- In PsB, P. truncatus was recorded during storage when maize was artificially infested with this species whereas in PPB, it was recorded in all bags with no difference between artificial and natural infestation.

Effect of PICS Bag (PsB) on insect mortality.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Mortality rate (%) /Kg</th>
<th>P. truncatus</th>
<th>S. zeamais</th>
<th>C. quadricollis</th>
<th>Tribolium sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 months of storage</td>
<td>6 months of storage</td>
<td>3 months of storage</td>
<td>6 months of storage</td>
<td>3 months of storage</td>
</tr>
<tr>
<td>PsB</td>
<td>100 Aa</td>
<td>100 Aa</td>
<td>95.83 ± 4.16 Aa</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PPB (Control)</td>
<td>100 Aa</td>
<td>96.43 ± 2.33 Aa</td>
<td>11.35 ± 1.71 Bb</td>
<td>7.38 ± 0.51 a</td>
<td>4.87 ± 0.56 a</td>
</tr>
</tbody>
</table>

- In PsB 100 % mortality of P. truncatus was obtained during the 6 months of storage.
- S. zeamais mortality was significantly lower in PPB than in PsB at each sampling with 100% mortality in PsB after 6 months of storage.
- Mortality rate of C. quadricollis and Tribolium spp in PPB also increased with storage time.
Effects of PICS Bag (PsB) on maize grain losses after 3- and 6-months

- Losses were significantly lower in PsB.
- No increase of losses in PsB.
- In control bag losses increased significantly with storage time reaching nearly 18%.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Months after storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 months</td>
</tr>
<tr>
<td>PsB</td>
<td>0.28±0.01 Aa</td>
</tr>
<tr>
<td>PPB</td>
<td>9.56± 0.34 Ba</td>
</tr>
</tbody>
</table>

If bags would be reused for a second storage season the benefit/cost ratio would increase to 3.7, 5.0 and 6.3
What R&D is missing

- High moisture content of grains in PICS bags could reduce germinability and lead to quality loss
- Need for low-cost energy efficient dryers to improve grain drying
- Potentially increase effectiveness of PICS bags by including another technology to reduce insect attack

- Test PICS bags for other commodities and include further quality parameters
- All stakeholders need to address the persistent high post-harvest losses

Acknowledgements

- PICS TEAM
- IITA
- NARS Partners
- Farmers Associations
- Women Associations
- Enumerators
THANK YOU