Storage technologies appropriate for decentralised village level food security

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Problem

A Womens’ Group in Mizapur (Andhra Pradesh) needed communal storage for sorghum that can keep the stock in good condition for at least eight months.

Group’s solution

To have a concrete bin and initial management support from IGSM-RI and CEC. A 13-tonne capacity concrete bin was constructed ready for the 2000 kharif sorghum harvest.
Reinforced-concrete grain bin at Mizapur
(13-tonne capacity)
Main features of bin

• Construction costs - US$720
• Annual management costs US$220 (includes IGSM-RI and CEC costs)
• Womens’ Group happy with size and location
• Not happy with
  – lack of partition
  – heavy concrete lid
  – moisture seepage through outlet pipe
Initial management strategy

- Grain sun dried for up to 15 days and then placed in gunny bags. Then bags emptied into silo.
- Periodic inspection for pests by farmers, IGSM-RI & CEC (monthly)
- Fumigation with phosphine if pest found (supervised by IGSM-RI)
What happened to grain quality

A gradual decline of kharif sorghum harvested October 2000

<table>
<thead>
<tr>
<th>Month</th>
<th>% moisture content</th>
<th>% discoloured grain</th>
<th>% damaged grain</th>
<th>% weeviled grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>10.1</td>
<td>4.0</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>February</td>
<td>9.0</td>
<td>3.8</td>
<td>0.6</td>
<td>1.3</td>
</tr>
<tr>
<td>April</td>
<td>9.0</td>
<td>5.1</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>June</td>
<td>9.1</td>
<td>5.2</td>
<td>0.7</td>
<td>1.7</td>
</tr>
<tr>
<td>July</td>
<td>9.3</td>
<td>4.8</td>
<td>0.9</td>
<td>2.3</td>
</tr>
<tr>
<td>September</td>
<td>9.4</td>
<td>5.0</td>
<td>0.8</td>
<td>3.1</td>
</tr>
<tr>
<td>November</td>
<td>9.4</td>
<td>5.1</td>
<td>0.9</td>
<td>4.2</td>
</tr>
<tr>
<td>December</td>
<td>9.5</td>
<td>5.1</td>
<td>0.9</td>
<td>5.4</td>
</tr>
</tbody>
</table>
Moving forward

Improvements to the bin

• Replaced lid with one of fibre glass construction,
• Sealed outlet port, but
• Unable to insert partition

and ……
... devising a sustainable grain management strategy

Objectives

• To prevent insect infestation without recourse to fumigation or admixture of synthetic insecticide.

• To introduce a procedure that farmers can implement without assistance of IGSM-RI or CEC

• Put 10 tonnes of kharif sorghum into the bin in Nov/Dec 2002 and retain good quality until about June 2003.
Suggested procedure

Grain solarization
How to solarize grain

1. Place grain in an envelope in the sun.
2. Hold grain at 50°C for about 6 hours.
Would there be enough sunshine for solarization?

Hyderabad airport during 1999 and 2000

Mean daily sunshine hours ± sem & mean no. rainy days

- Mean daily sunshine hours
- Mean rainy days

Months

January  February  March  April  May  June  July  August  September  October  November  December
Preliminary tests of solarization at IGSM-RI

Model solarizer tested

Clear polythene (folded under edge of black polythene)
Grain layer
Black polythene
Two layers of jute sacks for insulation
Questions to be answered

Test 1

1. How important is grain depth?
2. How important are the black layer and insulating layer?

- Grain - 11.8% mc and infested with *Sitophilus oryzae* and *Rhyzopertha dominica*
- Depth of grain layer 1 cm, 1.5 cm, 2 cm or 3 cm
- To be solarized 10 am to 4 pm
- After solarization, samples incubated at 27ºC for one month to check for any living insects
What happened

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Grain depth</th>
<th>Insect infestation after one month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full solariser</td>
<td>1.0 cm</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>1.5 cm</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2.0 cm</td>
<td>Moderate infestation</td>
</tr>
<tr>
<td></td>
<td>3.0 cm</td>
<td>Heavy infestation</td>
</tr>
<tr>
<td>No black sheet</td>
<td>1.0 cm</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>1.5 cm</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2.0 cm</td>
<td>Moderate infestation</td>
</tr>
<tr>
<td></td>
<td>3.0 cm</td>
<td>Heavy infestation</td>
</tr>
<tr>
<td>No jute bags</td>
<td>1.0 cm</td>
<td>Moderate infestation</td>
</tr>
<tr>
<td></td>
<td>1.5 cm</td>
<td>Moderate infestation</td>
</tr>
<tr>
<td></td>
<td>2.0 cm</td>
<td>Moderate infestation</td>
</tr>
<tr>
<td></td>
<td>3.0 cm</td>
<td>Heavy infestation</td>
</tr>
</tbody>
</table>

Conclusions

- grain depth should not exceed 1.5 cm
- black sheeting is unnecessary
- jute sacking is an essential insulation layer
**Questions to be answered**

**Test 2**

1. How important is the degree of sealing?
2. Does solarization affect grain germination?

<table>
<thead>
<tr>
<th>Sealing</th>
<th>Grain depth (cm)</th>
<th>Insect survival</th>
<th>Grain germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully sealed envelope- top and black layer</td>
<td>1.5</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>Moderate</td>
<td>None</td>
</tr>
<tr>
<td>Partially sealed envelope - top folded under</td>
<td>1.5</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>jute sacks</td>
<td>2.0</td>
<td>Moderate</td>
<td>None</td>
</tr>
<tr>
<td>Untreated grain</td>
<td>-</td>
<td>-</td>
<td>88%</td>
</tr>
</tbody>
</table>

**Conclusions**

- Envelope can be fully or partially sealed
- Grain for seed should not be solarized
Solarization in Mirzapur
December 2002

20 quintals in 3 days by 5 people

1.5 cm layer of grain
Clear plastic sheet

Tarpaulin
Two layers of sorghum panicles
Rock to seal edge of sheet
Solarization in Mirzapur contd

- Grain at 12% moisture content
- Maximum recorded temperature 52° C
- Immediately after treatment, grain placed in polypropylene bags
- Stored in Panhayat offices until all solarization completed, then placed in bin
- Bin painted with gas-tight paint and inlet and outlet ports sealed
What happened at Mizapur?

• Silo emptied March 2003 - drought led to shortened storage period. Some for sale, some to be donated to drought victims.