Periodic Physical Disturbance: An Alternative Method for Controlling Insect Infestation During Storage


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Outline

• Introduction
• Objective
• Study area & sampling
• Materials and methods
• Results and discussion
• Conclusions
Introduction

Cereal supply & demand, 2016; USDA, 2015; IGC, 2016

Global forecast 2016/17

- Maize: 896*
- Wheat: 734*
- Rice: 490*

*Million metric tons

Introduction

- Maize (corn) is the third most important cereal in the world

**World Maize Production (2015-2016)**

- United States: 13,601
- China: 8,841
- Brazil: 3,208
- Argentina: 1,008
- Ukraine: 925
- Mexico: 925
- Russia: 512
- EU-27: 2,274
- Canada: 535
- Other: 5,449

**World Total**: 38,105 Million bushels*

*1 bu = 25.40kg

USDA, FAS Grain (2016)
People in SSA*

> One billion

(IITA, 2009)

*Sub-Saharan Africa (SSA)
Introduction

< half of the calories in SSA

Macauley (2015)
Postharvest losses (PHL) of maize in SSA are very high - 5-20% (*APHLIS, 2013)

*APHLIS (African Postharvest Losses Information System) - 2013
Introduction

20%  $4 billion  >20 million
Introduction

• Tanzania is a major maize producer - E/Africa

• Cultivated area - 4.9 million ha (45%)

• A national average yield 1.0 - 1.5 t/ha

• Current postharvest losses of maize ≈ *9%

*APHLIS- African Postharvest Losses Information systems (2016)
Introduction

• It is grown in all regions

• **Over 85% by smallholder farmers**

• It is grown as staple food and cash crop

Maize production area in Tanzania (Cochrane & D’Souza, 2015).
Introduction

Maize production in Tanzania (2004-2014)
Introduction

The main causes of postharvest losses in developing countries include:

- Insects infestation
- Poor postharvest handling
- Poor storage structures
Introduction

• Most important insect pests of stored products (maize) in SSA

- *Sitophilus zeamais* (maize weevil)

- *Prostephanus truncatus* larger grain borer (Scania)
Introduction

- Chemical insecticides are commonly used to control insect pests of stored products

\[ \text{AIP} + 3\text{H}_2\text{O} \rightarrow \text{PH}_3 + \text{Al(OH)}_3 \]
Introduction

- Synthetic insecticides have resulted in numbers of drawbacks
  - Insect resistant
  - Chemical residues in foodstuffs
  - Health consequences to human & animals
Introduction

Physical control methods

• Alternative methods to prevent & control stored product pests
  - based on the application of some kind of force
  - creates unfavorable conditions to pests

• It includes method like
  - heat, cold, inert gas,
  - impact or physical disturbance (Bbosa et al., 2014)
Objective

• The objective was to determine the practicability of periodic physical disturbance on *S. zeamais*, the maize weevil mortality by substance farmers in developing countries
Study area & sampling

- **Gallapo-village**: Two women, One man
- **Ikowa-village**: All women
- **Mambwerembwere**: One woman, Two men

Population: 19,578
Population: 7,155
Population: 6,325

Total farmers = nine (9)
The study employed a farmer participatory research approach.
Materials & methods

• Each farmer was given 12 plastic containers

• Manyara region – 3 x 12 = 36

• Dodoma region – 3 x 12 = 36

• Morogoro region – 3 x 12 = 36

• Total treatments = 108
Experiment setup

• Three storage time
  30, 60, & 90 days

• Two treatment
  - turning
  - control

• Three replications
Experiment setup

• A 10 kg of fresh white dent corn & 0.50 kg of maize infested with *S. zeamais*

• **Initial & final numbers** of *S. zeamais* was determined

• **Turning treatments**—*disturbed twice a day* (early in the morning and late in the evening)
Experiment setup

Control/stationary

Turning/ tumbling treatments

Storage time (d)

$C_1$

$C_2$

$C_3$

$T_1$

$T_2$

$T_3$

$T_4$

$T_5$

$T_6$

$T_7$

$T_8$

$T_9$

30

60

90
Experiment setup

• Controls - were not disturbed or untouched until the end of storage.

• Percent mortality was calculated by

\[
\text{\% Mortality} = \frac{\text{Number of dead insects}}{\text{Total number of insects}} \times 100
\]

• Data were analyzed using SAS (version 9.4)
Results & discussion

• The overall percent mortality after 30, 60 & 90 days of storage were 88%, 96%, & 98%
# Results & discussion

- **Number of live *S. zeamais***

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Control (Stationary)</th>
<th>Turning treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dodoma</td>
<td>Manyara</td>
</tr>
<tr>
<td></td>
<td>Dodoma</td>
<td>Manyara</td>
</tr>
<tr>
<td>30</td>
<td>$20 \pm 8.33^c$</td>
<td>$12 \pm 4.00^c$</td>
</tr>
<tr>
<td>60</td>
<td>$68 \pm 31.24^b$</td>
<td>$77 \pm 44.06^b$</td>
</tr>
<tr>
<td>90</td>
<td>$109 \pm 22.03^a$</td>
<td>$152 \pm 35.73^a$</td>
</tr>
</tbody>
</table>
Conclusions

• The study determined the practicability of periodic physical disturbance

• The study shows potential of physical disturbance
  - feasible & effective
  - simple, affordable & safe

• Can eliminate chemical contamination of maize
thank you!

Questions?