ZIMBABWE SUGAR ASSOCIATION EXPERIMENT STATION

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BIOSECURITY IN SUGARCANE PRODUCTION

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INTRODUCTION

Biosecurity

- Preventative measures designed to reduce the risk of transmission of infectious diseases in crops and livestock, quarantined pests, invasive alien species and living modified organisms
- Set of measures designed to protect a property (crops, animals) from the entry and spread of pests and diseases

Necessity of Biosecurity program

- Ongoing and vital issue in sugarcane industries of the SADC region; important to all stakeholders
- Pests & diseases do not recognize borders
What are the biosecurity risks in sugarcane production in the SADC region?

- **New Diseases:** Orange rust; African/Ash rust; downy mildews, grass shot & white leaf diseases

- **New races/strains of diseases already present:** Smut, leaf scald, brown rust, RSD, viral infections in legal or illegal imported propagation material

- **New insect pests:** sugarcane stalk borer (*Chilo sacchariphagus*), sugarcane thrips (*Fulmekiola serrata*), yellow sugarcane aphids (*Sipha flava*), invasive fruit fly (*Bactrocera invadens*)
What can be done to mitigate biosecurity risks in sugarcane production?

- Legislation in SADC member states
  - Regulate movement of planting material within & out

- Education
  - Posters/leaflets at borders; farmer training

- Monitoring
  - Surveys along borders, growers fields

- Research
  - Identification; host specificity; management strategies

- Administration
  - Collaboration
A Biosecurity initiative in the region: monitoring *Chilo sacchariphagus* (Lepidoptera: Crambidae) in Zimbabwe, South Africa & Swaziland
INTRODUCTION

Biosecurity program for southern Africa (coordinated by SASRI): vital for pests & diseases incursion: e.g. Chilo program

Chilo sacchariphagus – spotted stalk borer

Pest status worldwide: indigenous to and key pest in SE Asia & the Indonesian Islands; affects biomass more than sucrose

Pest status in Africa: introduced into the Indian Ocean islands & Mozambique (northern estates?); key pest & affects biomass more than sucrose

Symptoms and damage in sugarcane: shoot holes on young green leaves (shoot borer); stalk tunneling from top; side shoots on damaged cane
Chilo sacchariphagus: moth, eggs, larva; and damage indications (courtesy of SASRI)
SASRI Objectives of program

Reduce the biosecurity risk of *Chilo sacchariphagus* in the region through:

- Monitor pest presence using pheromone traps
- Awareness campaigns through workshops, grower meetings & publications
- Collaborative research projects on bio-control
- Development of an incursion plan in the event of pest invasion
Monitor stalk-borer populations using cane stalk surveys in Zimbabwe and pheromone traps in South Africa and Swaziland
METHODOLOGY

• Identify ‘chewing’ cane growing areas along border with Mozambique
• Select smallholder plots with > 20 cane stools
• Randomly select sugarcane stalks from stools
• Split stalks and assess for borer damage
• Collect borer developmental stages found
• Borer identification using molecular techniques (SASRI)
• Pheromone traps in Swaziland & South Africa along border with Mozambique
Observations

- Two major areas along Zim-Moz border with high chewing sugarcane cultivation
- Rusitu Valley characterized by smallholder terraced plots that:
  - Harness flowing water from the mountains/hills
  - Chewing cane demarcates plots and separates ‘beds’ of different crops
  - Mixed farming practiced: chewing cane, banana, citrus, avocado, maize, cocoyam (*Colocasia esculentus*), cassava, sweet potatoes, pineapple, sugarbean/peas, leafy vegetables
Relief map of Zimbabwe showing two areas (in red) that have a high concentration of chewing sugarcane production.
Some of the sampling points in the Rusitu River Valley
Shallow water channel; protected with grass and cocoyam
Chilo Monitoring

In Mozambique Chilo monitoring continues on the four main sugar estates. The pest has not been detected on the southern estates.

- Monitoring programmes consisting of grids of chilo pheromone-baited delta insect traps have been operational in Swaziland and in South Africa in the surrounds of the Makatini flats, and the pest has not been detected.

- Some Chilo monitoring equipment has been stockpiled at SASRI for immediate deployment in the event of a report from a new area (contact: Mike Way, 031-5087489, mike.way@sugar.org.za).


The regional biosecurity programme is underpinned by accurate identification of material.

Molecular taxonomic techniques and classical morphological methods are used to achieve this task at SASRI.

Lauren Martin from SASRI provides an identification service of unknown insect material.
RESULTS

• Smallholder details and borer damage (%bs)

• Identification of larvae and pupae collected during 2012 survey

• No *Chilo sacchariphhus* identified to date in Zimbabwe, Swaziland & South Africa
### Summary of surveys conducted in 2011, 2012, 2013 in Rusitu Valley

<table>
<thead>
<tr>
<th>Survey period</th>
<th># of smallholder plots assessed</th>
<th># stalks collected</th>
<th>% bored stalks (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2011</td>
<td>41</td>
<td>766</td>
<td>7.7</td>
</tr>
<tr>
<td>September 2012</td>
<td>64</td>
<td>2657</td>
<td>6.9</td>
</tr>
<tr>
<td>May 2013</td>
<td>60</td>
<td>2493</td>
<td>5.9</td>
</tr>
<tr>
<td>Total (to date)</td>
<td>165</td>
<td>5916</td>
<td>6.8</td>
</tr>
</tbody>
</table>


### Identification of 22 samples using COI sequencing techniques; BOLD and/or NCBI BLAST databases used

<table>
<thead>
<tr>
<th>Seq'ing sample no</th>
<th>Sample</th>
<th>Location</th>
<th>Identification based on COI sequence</th>
<th>Similarity / Max ID</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zim 1</td>
<td>ZW F002 larva</td>
<td>Rusitu Valley</td>
<td><em>Sesamia calamistis</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 2</td>
<td>ZW F009 larva 1</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 3</td>
<td>ZW F009 larva 2</td>
<td>Rusitu Valley</td>
<td><em>Omosita discoidea</em></td>
<td>85%</td>
<td>NCBI</td>
</tr>
<tr>
<td>Zim 4</td>
<td>ZW F010 larva</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 5</td>
<td>ZW F030 larva</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 6</td>
<td>ZW F033 larva</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 7</td>
<td>ZW F034 larva</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 8</td>
<td>ZW F035 pupa</td>
<td>Rusitu Valley</td>
<td><em>Chilo partellus</em></td>
<td>99.82%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 9</td>
<td>ZW F037 larva</td>
<td>Rusitu Valley</td>
<td><em>Sesamia calamistis</em></td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>Zim 10</td>
<td>ZW F040 larva</td>
<td>Rusitu Valley</td>
<td><em>Cotesia vestalis</em></td>
<td>96%</td>
<td>BOLD</td>
</tr>
</tbody>
</table>
Identification of 22 samples using COI sequencing techniques; BOLD and/or NCBI BLAST databases used (contd)

<table>
<thead>
<tr>
<th>Zim</th>
<th>Sample ID</th>
<th>Location</th>
<th>Species</th>
<th>Identity %</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>ZW F041</td>
<td>Rusitu Valley</td>
<td>Sesamia calamistis</td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>12</td>
<td>ZW F044</td>
<td>Rusitu Valley</td>
<td>Sesamia calamistis</td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>13</td>
<td>ZW F044</td>
<td>Rusitu Valley</td>
<td>Chilo orichalcociliellus</td>
<td>99.65%</td>
<td>BOLD</td>
</tr>
<tr>
<td>14</td>
<td>ZW F045</td>
<td>Rusitu Valley</td>
<td>Chilo orichalcociliellus</td>
<td>99.82%</td>
<td>BOLD</td>
</tr>
<tr>
<td>15</td>
<td>ZW F045</td>
<td>Rusitu Valley</td>
<td>Chilo orichalcociliellus</td>
<td>99.44%</td>
<td>BOLD</td>
</tr>
<tr>
<td>16</td>
<td>ZW F049</td>
<td>Rusitu Valley</td>
<td>Oncocera faecella</td>
<td>90%</td>
<td>NCBI</td>
</tr>
<tr>
<td>17</td>
<td>ZW F054</td>
<td>Rusitu Valley</td>
<td>Albinaria lycica phaselis</td>
<td>74%</td>
<td>NCBI</td>
</tr>
<tr>
<td>18</td>
<td>ZW F059</td>
<td>Rusitu Valley</td>
<td>Busseola fusca</td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>19</td>
<td>ZW F059</td>
<td>Rusitu Valley</td>
<td>Busseola fusca</td>
<td>100%</td>
<td>BOLD</td>
</tr>
<tr>
<td>20</td>
<td>ZW F060</td>
<td>Rusitu Valley</td>
<td>Odesia sp.</td>
<td>88%</td>
<td>NCBI</td>
</tr>
<tr>
<td>21</td>
<td>ZW F060</td>
<td>Rusitu Valley</td>
<td>Oncocera faecella</td>
<td>90%</td>
<td>NCBI</td>
</tr>
<tr>
<td>22</td>
<td>ZW F062</td>
<td>Rusitu Valley</td>
<td>Sesamia calamistis</td>
<td>100%</td>
<td>BOLD</td>
</tr>
</tbody>
</table>
### Summary of insect species identified from the Rusitu Valley collections

<table>
<thead>
<tr>
<th>species</th>
<th># out of 22 samples</th>
<th>% occurrence</th>
<th>Database used</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sesamia calamistis</em></td>
<td>5</td>
<td>22.7</td>
<td>BOLD</td>
</tr>
<tr>
<td><em>Chilo partellus</em></td>
<td>6</td>
<td>27.3</td>
<td>BOLD</td>
</tr>
<tr>
<td><em>Chilo orichalcociliellus</em></td>
<td>3</td>
<td>13.6</td>
<td>BOLD</td>
</tr>
<tr>
<td><em>Busseola fusca</em></td>
<td>2</td>
<td>9.1</td>
<td>BOLD</td>
</tr>
<tr>
<td><em>Oncocera faecella</em></td>
<td>2</td>
<td>9.1</td>
<td>NCBI-BLAST</td>
</tr>
<tr>
<td><em>Odesia sp</em></td>
<td>1</td>
<td>4.6</td>
<td>NCBI-BLAST</td>
</tr>
<tr>
<td><em>Omosita discoidea</em></td>
<td>1</td>
<td>4.6</td>
<td>NCBI-BLAST</td>
</tr>
<tr>
<td><em>Cotesia vestalis</em></td>
<td>1</td>
<td>4.6</td>
<td>BOLD</td>
</tr>
<tr>
<td><em>Albinaria lycica phaselis</em> (snail)</td>
<td>1</td>
<td>4.6</td>
<td>NCBI-BLAST</td>
</tr>
</tbody>
</table>
INFERENC

- *Chilo sacchariphus* has not yet spread into Zimbabwe, Swaziland and S. Africa from Mozambique: physical barriers? climatic conditions?
- Other borers (*C. orichalcociliellus, C. partellus, B. fusca, S. calamistis*) were collected from sugarcane (potential pests in cane?)
- Mixed crop cultivation as practiced in Zimbabwe eastern highlands (potential hosts for other pests and diseases? Or natural enemies)
- Use of Molecular Techniques for identification of insect pests and development of a database for the region
Regional Collaboration

- SASRI continue to drive the regional biosecurity
- Several workshops have been held, most recently in Swaziland. A local meeting was held at Big Bend in Swaziland.
- Two fruitful meetings were convened with RSA-Mozambique border post officials in at Golela gate (13th March 13) and Nelspruit (13th Sept 12). The next chilo workshop will be held on 13-14th August 2013 in Swaziland at Hlume.
- Key members of the regional biosecurity programme e.g. Rowan Stranack, SASRI-Biorisk manager have visited Mafambisse estate to gain first-hand experience of the devastation caused by Chilo pest.
Chilo Regional Bio-Security Program: Public awareness

Thank you for helping us keep track of this pest.

Biosecurity Hotline: 27 83 561 2781

South African Sugarcane Research Institute

www.sugar.org.za

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ACKNOWLEDGEMENTS

Â Zimbabwe: Min. Agriculture & Rural Development: Depart. Agric. Extension Services; traditional chiefs & headmen, and plot owners in Rusitu Valley; SASRI for insect identification & collaboration. ZSAES for funding.

Â South Africa: SASRI & relevant departments of SASA & South African government

Â Swaziland: SSA & relevant departments & Swaziland government
Thank you

Multipurpose use of water
Good crop of cane after harvesting an equally good crop of maize: farmer very happy
Thank you